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S. D. KIRKPATRICK, Editor

March, 1932

Confirming Mr. Kettering

IN CASE he is interested, that astute student of science and business who guides the research activities of General Motors can find considerable personal satisfaction in the way his views on the earning power of new products are now being confirmed by the balance sheets of many chemical companies. More than one of these otherwise prosaic documents point out that more profits are being made from new ideas than from cutting costs on existing products and processes.

THE PRESIDENT of a leading alkali company reports to his stockholders:

> The past year forcefully demonstrated the wisdom of developing new and special products which have added to our earnings, inasmuch as our standard products suffered severe price declines.

ONE of the most illuminating financial statements that have come to our desk in recent months is the thirtieth annual report and year book of a chemical company of international importance. The fact that its profits increased by 75 per cent in 1931 may be explained in part by the following quotation:

> The character of M—'s research is changing. That of the past decade was in a great measure devoted to refinement of the processes for existing products and less emphasis was placed on new materials. . . Our present products will always receive the emphasis their importance warrants, but our efforts from this point on will be in an increasing degree directed toward finding new applications for current products, their conversion into a higher state of manufacture, and toward searching for new products for which unfilled needs exist.

A LETTER received from a small but exceedingly enterprising manufacturer of heavy chemicals on the Pacific Coast has this to say about last year's profits:

> We have four chief products, two that are old and two that are new—or, rather, improved—forms of old materials. With the old products we have cut costs in the usual way and with only moderate success, as we have been forced to decrease our margins of profit considerably during the year. Our two new or improved products, though in production less than a year, show four times as high a profit percentage as our standard lines and are growing much faster in volume. Incidentally, we find that a small company, because of its low inertia, is better able than a larger firm to use this technique of improving its products.

A PRODUCER of pharmaceutical and biological chemicals, whose profits in 1930 increased over those of 1929 and were still better in 1931, despite lower sales, offers this explanation:

> Our new products developed to meet real needs have taken up the slack caused by uncontrollable shrinkage of volume and have yielded enough more sales to account for our current increase over 1930. We do not depend upon a synthetic enthusiasm of the sales force to keep our volume growing in times like these. Good products properly designed for current demand do their fair share of the selling and thus do not leave the entire burden on the salesmen.

ALL of these statements, we believe, have a peculiar significance right now for the chemical engineer in production, as well as in research and development work. If he is awake to his responsibilities he realizes that his job demands something more than the continued drive to reduce costs by increasing efficiency and eliminating waste. Desirable in all times, that course is now absolutely essential to self-preservation for many companies. But even beyond this, the production man's responsibility must extend to the development of new products to meet real needs. And it does not end until he can produce them at a profit. In other words, his single most important objective is to find out what is wanted and then to make it of a quality and at a price that meet the customer's requirements.

WE HAVE only the greatest respect and admiration for those hard-hitting, fair-fighting production men who have cut operating costs to the very limit, even though these gains were sometimes wiped out by lower selling prices. But the records of 1931 clearly show that the companies that made most money were those that discovered the way to make and sell new or improved products on a non-competitive and, therefore, more profitable basis. So far, 1932 has revealed no better formula.

EDITORIALS

MARCH, 1932

But Is It True Economy?

CAN it be that management is mistaking the mad budgeting of 1932 for economy? Economy is not retraction or defeat. Economy is the full employment of intelligent planning in research as well as in production and distribution. Economy presupposes the use of brains and foresight. The handful of companies that wrung a better profit out of 1931 than out of 1930 merely applied the essential wisdom of the fundamental law that he who would receive must give—and give in the proportion that he would receive. No lasting improvement can come about until many companies rediscover the basic wisdom in the law of give and take. This applies particularly to the employment of thousands of scientifically and technically trained men in the process industries. Some of the best of these men are now being offered up as sacrifices at the feet of the grinning god BUDGET. Managements have sliced 1932 budgets far beyond the evaporation point of economy, forgetting that economy is the adequate and efficient employment of intelligent planning and execution. Reestablish a true sense of economy and this sniping of technical men will cease.

Further Change Needed In Denaturing Formulas

METHANOL as a denaturant has long been a storm center in the program of industrial alcohol regulation. When it became necessary for administrative officials of the Treasury Department to cancel formulas using 10 per cent of methanol on the score of public safety it was recognized by all that the new formulas substituted were not ideal and might require further change. Shortly thereafter one such change was made in order to eliminate the excessive odor and other troubles incident to the use of CD5 in paint, varnish, and shellac. The experience of the past winter with denatured alcohol as an anti-freeze shows that still another change is necessary.

Naturally, producers of wood-distillation methanol would ask that Commissioner Doran should restore CD1 using 10 per cent methanol without the odorous twins, aldehol and alcotate. Certainly these twins must be further disciplined in order that they do not make denatured alcohol impossible as an anti-freeze in a mild winter. As now constituted the formula which includes them that is intended for anti-freeze purposes is odorous oftentimes beyond the tolerance of the automobile user.

It has been proposed that a modified and less violently odorous denaturant be used, and we believe that such a change is absolutely essential if ethyl alcohol is to continue to hold its place in the anti-freeze market. The only alternative appears to be the restoration of CD1 with 10 per cent methanol and the resumption of the battle over "poison liquor" and "legalized murder." From the standpoint of technology and the chemical engineering industries we should prefer to see the restoration of CD1. We know the value of that formula; we know that it serves industry satisfactorily. Convincing evidence of this fact may be seen in the striking increase during recent months in the use of the specially denatured alcohol in which methanol is still permitted.

It is becoming increasingly apparent that most of the political opposition to methanol was based on misinformation. On the other hand, it is just as obvious that Commissioner Doran would be placed in an embarrassing, if not untenable, position by a reversal of his previous decision, unless and until it has been convincingly demonstrated that there is no other way to accomplish denaturing which is effective for law-enforcement purposes without being obnoxious to the user. It is greatly to be desired that those who control the formulas for completely denatured alcohol find a way to steer between the Scylla of politics and the Charybdis of public nuisance.

Is It Another Muscle Shoals?

PARADING behind the banner of unemployment relief, certain zealous citizens of the Pacific Northwest are urging Congress to authorize the federal expenditure of almost $400,000,000 for a Columbia River Basin power and irrigation project that would develop a little more than 2,000,000 hp. and bring under cultivation 1,250,000 acres of additional irrigated land. To propose that Uncle Sam buy another white elephant to add to his Muscle Shoals-Boulder Dam menagerie seems ludicrously out of keeping with the times. Under normal circumstances we would regard this activity as purely political and, therefore, harmless but entertaining propaganda. Now, however, there is in it an element of real danger, since the alleged justification for starting the project at this time is the "immense power outlet offered by the chemical industries that will locate in the Northwest."

Not all of this promotional activity centers in Washington. The 1931 Legislature of Oregon, according to a highly colored report made to the Governor of that state by a former state engineer, has declared itself in favor of the use of public, low-interest, tax-free funds for the development and transmission of power and its sale at cost "so that the Northwest states may be in a position to offer the cheapest power rates on the American continent and fully compete with the cheap coal conditions in the East." Rates as ridiculously low as $9.10 per horsepower year at the power site are mentioned in this report.

There is a glowing picture of a forthcoming "aluminum age when everything which moves will be made largely from the light aluminum alloys" to become available "as the price is reduced through the use of cheap power on the Columbia River." This does not preclude, however, an equally attractive iron and steel industry based on surface iron ore deposits near Portland, Oregon, "that may eventually rival the famous Mesabi Range." Likewise chrome ore located in southern Oregon and northern California will be combined with cheap power and the local iron ore to make ferro-chromium that "can successfully compete with the imported product." But

to quote further, "the most promising market for large blocks of hydroelectric power appears to be in the fertilizer and chemical industry. Conditions here are most favorable. We have in the Columbia River Basin the richest and most extensive phosphate rock deposits in the world." And so the report goes on, through newsprint and back to the metals—tin, lead, and antimony—for eleven pages of closely spaced type.

Even the more conservative proponents of the plan for the immediate development of the Columbia River Basin admit that this chemical and metallurgical market for power is the only way out. Without the revenue they expect to derive from these industries, the project cannot be made self-supporting. Even if turned over to the Reclamation Service, with the necessary appropriations for the dam and irrigation equipment, it would ultimately fail without the sale of hydroelectric power.

It is inevitable, of course, that in the orderly growth of the process industries there will be important developments in the Pacific Northwest. Just as was the case at Muscle Shoals, however, such migration will be greatly retarded if not entirely prevented if the government permits itself to be rushed into an unnecessary and uneconomic project on the false assumption that there is a large present or prospective demand for power in this territory by the chemical and electrothermal industries.

Proper Packaging Offers a Better Remedy

AT the request of certain flour millers, several bills intended "to require the discoloration of poisons which resemble commonly used foodstuffs" have been introduced in the United States Senate and in the House of Representatives. They propose a drastic remedy for the ills resulting from the occasional misuse of poisonous substances like calcium and lead arsenates that resemble flour only in their appearance.

Without in any way questioning the humane motive behind this proposal, we believe that chemical industry cannot afford to accept the underlying principle that merely because certain careless merchants or certain ignorant persons in the household may mishandle valuable chemicals the usefulness of these materials must be destroyed or restricted for the vast majority of users. Let even a narrowly phrased law require discoloration of some substances like calcium arsenate and we would shortly have more and more additions to the law elaborating on the principle until an impossible situation with reference to chemical marketing would result. As a matter of fact color alone offers no assurance whatsoever that the chemicals will not be mistaken for some other substance instead of flour or baking power.

The more logical corrective measure lies in the proper packaging and labeling of the goods. The scheme of selling calcium arsenate in paper bags from a keg under the general-store counter, as is said to be common in the South, should be stopped. It costs so little more to put any such chemical into a clearly labeled container of any size required by the household purchaser, that the manufacturers themselves can readily eliminate much of the cause of difficulty. It would be no hardship, for example, to have either state or federal regulations forbidding the sale of bulk chemicals of this character in packages that might easily be confused with foodstuffs. Such a restriction would not be unreasonable, but to attempt to change the character of the chemical itself would impose an intolerable limitation.

Chemical Engineering Trends In Methods of Sewage Treatment

THOSE who are in a position to observe the trends in sewage disposal see a movement under way that is likely to become of increasing importance to chemical engineers. There is a growing realization that further progress with the activated sludge and other biological methods of sewage treatment—particularly in the case of the larger cities—will depend almost entirely upon the development of better means of sludge disposal. It is significant that a most thorough study is now being given to filtering, drying and incineration—true, chemical engineering operations for which a wide variety of equipment is already available while many new and more efficient machines are constantly being developed.

Some attention is being given to the combustion values of sewage in relation to heat and power generation, but perhaps the more evident trend is toward the use of combustible gases obtained from the digestion of organic solids in sewage sludge. Heretofore the gas has been used principally for heating water, which is subsequently circulated through pipes to transfer the heat to the sludge. Now there appears to be an advantage in the use of the gas directly for power in internal-combustion engines direct-connected to electrical generators.

Another interesting observation is that chemical precipitation, one of the first methods of sewage treatment, which was subsequently abandoned in favor of the biological methods, has been undergoing something of a revival, although in a slightly modified form. Advantage is now being taken of the greater progress that has been made in the chemical industries, not only in precipitation and sedimentation but also in producing sludge of a character that can be filtered more readily. If the proper conditions can be found to produce high rates of filtration, the vacuum filter is likely to displace the old sludge-drying beds—analogous in a way to the progress made in displacing the early slow-sand water filters by the rapid, mechanical filters of today.

Perhaps it is too soon to foresee all of the directions in which these trends may lead, but it is evident that all involve some application of chemical engineering methods and equipment. It is quite conceivable, therefore, that within the next few years the chemical engineer will find that the problems of sewage disposal will offer a much more fertile field for intensive cultivation.

Correlating Modern Technology for a Heavy Chemicals Industry

By E. BORELLI

Manager, Compagnie Néerlandaise de l'Azote
Sluiskil, Holland

ITS situation on the lowlands of Dutch Zeeland, below sea level and inaccessible to quick inland transportation, but highly favorable to water commerce, indicates the type of industry for which Sluiskil would be a suitable center. It would need to be self-contained, independent of large labor requirements, based on simple raw materials, and confident of distant markets.

On this basis the Association Coopérative Zélandaise de Carbonization was constructed in 1911 on a shipping canal at Sluiskil, disposing of its large coke production to French metallurgical works which were financially interested in the plant. The byproduct gas, for want of market, had to be largely destroyed. The need for an outlet, however, caused the Cie. Néerlandaise de l'Azote to be founded in 1926, the interests being held by the Italian Montecatini, the Belgian Evence Coppée, the Banca Commerciale Italiana, the Banque de Bruxelles, and the coke works. The actual nitrogen plant was not begun until 1929, but the first operations were started in October, 1930.

The company's property, totaling roughly 200 acres, is situated between a railroad line and a canal to which a subsidiary canal for maritime vessels has been constructed. This latter has entailed extensive demolition and reconstruction work in dwellings, bridges and docks, the newest of which has a useful length of 250 meters and capacity for boats of 8,000 tons. The total quantity of material that can be handled on the dock, including raw materials of all sorts and finished products, is 200 tons an hour and 500,000 tons in a year.

Process water, of which considerable quantities are used, is obtained directly from the canal, by permission of the Dutch authorities, on the condition that it be returned in its original purity. Because the plant is below water level, an additional pumping station is necessary; rain water or seepage is collected as part of the provincial drainage system. Naturally, the intimate connection of the canals with the sea results in the presence of salts varying from 2 to 6 grams per liter; for most purposes, therefore, an extensive purification is necessary.

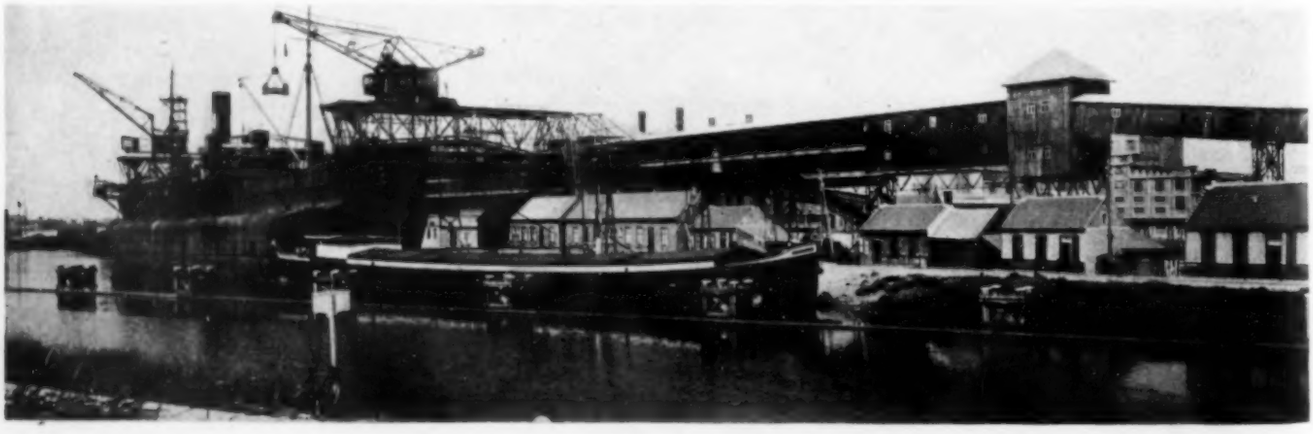
For the many operations of the chemical plants, some 150,000,000 kw.-hr. of electrical energy is needed annually. Such a supply was not available in the district, nor did the Dutch authorities approve of importation from near-by Belgian sources. For this reason, and also to secure a dependable supply, an electric power station was constructed between December, 1929, and November, 1930. It is now favorably situated close to the canal and to the chemical plant. The sandy soil required that it be constructed on piles reaching 15 meters deep.

Two groups of 20,000-kw. turbo-generators, with a normal output of 16,500 kw. each, supply the current, space being available for later additions. There is a rather complicated system of heat exchange, due to the necessary water purification and the close interrelation with the chemical plant. The constructing firm guaranteed a consumption of 2,600 calories per kilowatt-hour and this figure has been attained in practice. The current is delivered to the plant at 6,000 volts. Four boilers are provided for the steam, any two of which are capable of supplying 20,000 kw.

Producing Hydrogen-Nitrogen Mixture

The system chosen for the separation of hydrogen was refrigeration, because it gives both a good yield and a very pure mixture; the Linde-Bronn process is the one in use. The gas available from the ovens is about 800,-

New Shipping Dock at Sluiskil for Raw Materials and Products



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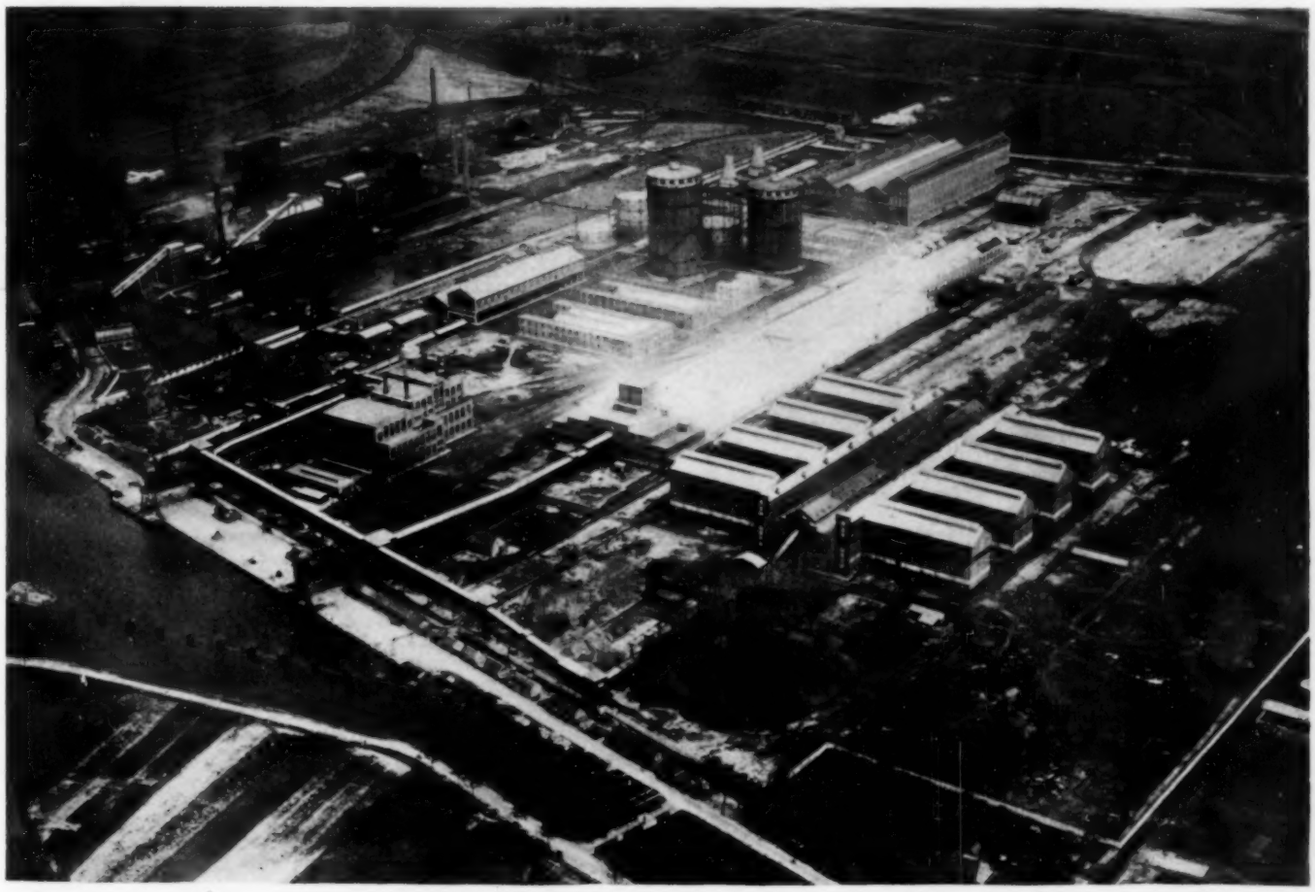


000 cu.m., but since coke operations are not sufficiently constant, a water-gas plant has been introduced in order to sustain a constant supply. With 80,000 cu.m. of hydrogen thus available every day, the plant can operate at a constant maximum.

A daily supply of coke-oven gas of 800,000 cu.m. necessitates four Linde liquefaction units, treating about 8,500 cu.m. of gas each hour. Each unit comprises a Schwartzkopf compressor (1,250 hp.) handling 8,500 cu.m. per hour, a Sürth nitrogen compressor (900 hp.) for 2,400 cu.m. per hour, a Sürth air compressor (750 hp.) for 2,700 cu.m. per hour, and two Esslingen compressors for the benzol removal and for fractionation, and the further equipment for washing gases, for debenzolization, and for fractionation of the gases. The gas taken from the coke works is sent by centrifugal blowers to iron oxide purification chambers for sulphur removal. After this the clean gas is collected in another holder, whence it is fed to the compressors.

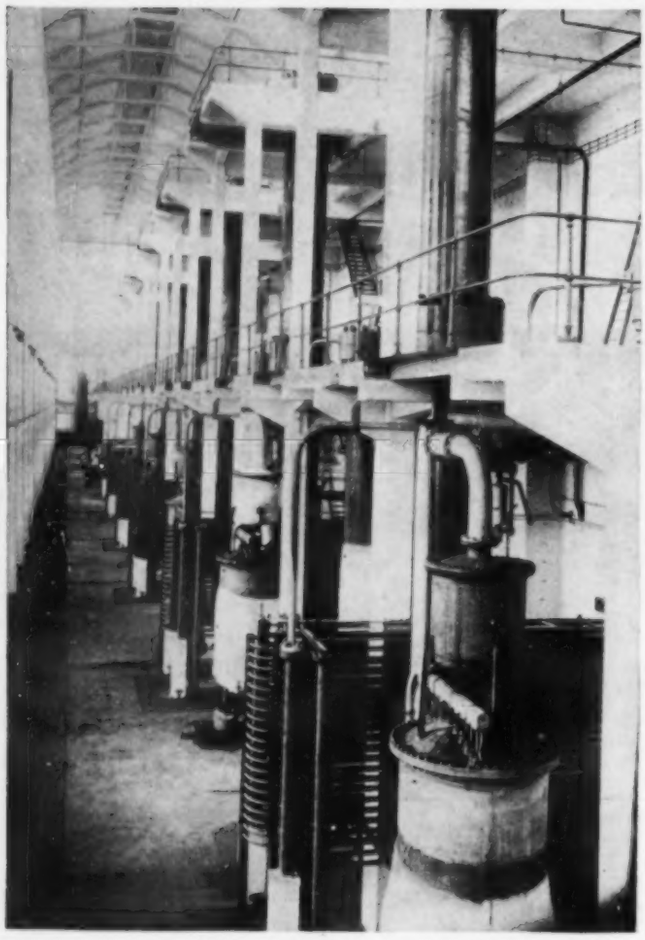
Further benzol removal is effected by refrigeration in ammonia towers. The removal of carbon dioxide from the air and from the combustion gases is effected in both cases by caustic soda, in the first under a compression of 3 kg., and in the second, after a system of water scrubbing, under 12 kg. compression. Excess nitrogen produced in the fractionating equipment is collected in a gas holder.

For the remainder, this installation does not differ from other Linde plants, already sufficiently described in the literature. All compressors, pumps, pump control boards, for fractionation as well as for synthesis, are assembled in a single building on an elevated floor. All pipes, wires, refrigerating coils, and so on are below on the ground floor. Motors are remote controlled, from a transverse passageway which affords a view on all operations.

Concentration of operations in large units has given favorable results with respect to gas yield, energy consumed, and economy in manual labor. The hydrogen yield is 92 per cent of that contained in the coke-oven gas, and the energy consumption does not exceed 0.45 kw.-hr. per cu.m. of final gaseous mixture.

Synthesis of Ammonia

For the various reasons cited further below, the Fauser process for ammonia synthesis has been chosen, this plant representing the largest installation in operation. The economies realized by use of a pressure of



Ammonia Synthesis Reaction Chambers

250 to 300 kg. for the reaction represents close to 25 per cent saving in power as compared with similar operation under 600 to 800 atm. In contrast with other low-pressure processes, this system uses an activated iron oxide catalyst. It has been found to require an average renewal of once a year.

The synthesis plant comprises five compressors handling 6,000 cu.m. per hour; two compressors handling 2,500 cu.m., six reaction towers, each producing 35 to 40 tons of ammonia a day; and two preliminary converters, the total capacity of the plant being 200 tons of ammonia per 24 hr. The preliminary converters transform any residual carbon monoxide into methane, which is not a catalyst poison. Every synthesis unit consists essentially of the reaction chamber proper, a water cooler, a column for condensation and separation of liquid ammonia, an ammonia evaporator and a circulating pump. Very little manual labor is required: only one man is needed to perform all operations on two synthesis units.

The gaseous mixture coming from the Linde plant at 12 kg. pressure is further compressed to 250 kg. by five 4-stage compressors handling 6,000 cu.m. and two compressors handling 2,500 cu.m. an hour. Preliminary heating of the reaction chambers is produced by electrical resistances in the interior, but once reaction has started, the current is shut off. The total energy requirements of the installation are 0.5 kw.h. per kg. of ammonia.

The ammonia produced in the synthesis is consumed in ammonium sulphate manufacture, according to the Fauser process (*Chem. & Met.* **38**, 456-7,1931). In contrast to the ordinary processes in liquid medium, which give a moist and acid product necessitating further treatment for producing dry sulphate, this process operates in a dry phase, giving the product directly. This is marketed either in a powdered form as it is made or in granulated form by further treatment.

The necessary equipment consists essentially of steel reaction chambers in which the ammonia is introduced in the bottom and meets a shower of acid distributed through the top. The sulphate formed drops to the bottom of the chamber, where it is removed by a screw conveyor, while the vapors, consisting of water vapor and sometimes traces of ammonia or acid, pass out to an acid scrubbing system before returning to the reaction chambers. By substitution of some other acid for sulphuric it is easily possible to obtain other ammonia salts.

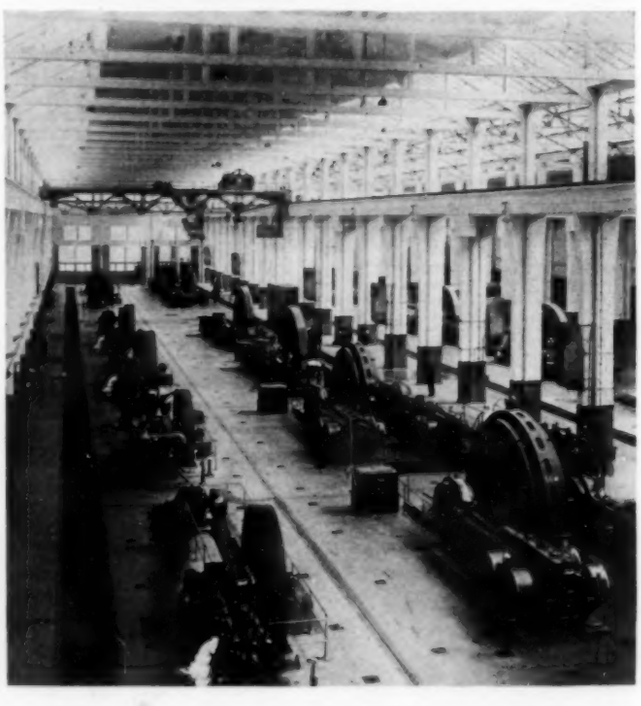
Among the economies effected in operation are greatly reduced manual labor, because of the central control and mechanical procedure, and the low maintenance charges, corrosion being to all practical purposes entirely absent. This installation can produce up to 800 tons of ammonium sulphate in 24 hours and includes storage facilities for 60,000 tons of material. These are supplemented by various loading and charging equipment for immediate shipment by sea or rail.

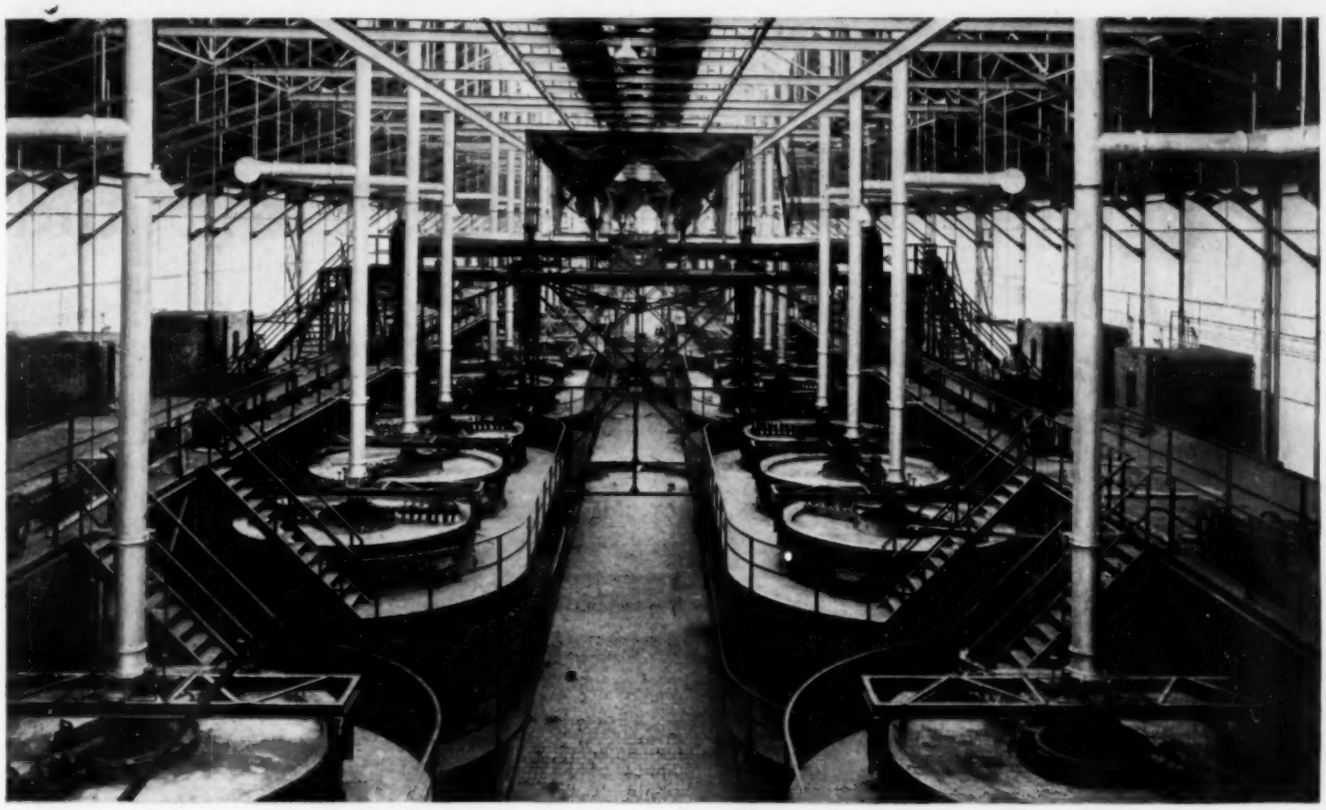
In order to obtain the acid necessary for the ammonium sulphate, a plant has been constructed to produce 640 tons of 60 deg. Bé. acid per 24 hr. The building consists of a steel and brick structure 160 m. long and 150 m. broad. In a long central hall, the furnaces are set up in a double row; and in eight annexes (four wings on each side of the central hall) are the lead chambers. Two long passageways pass over the Glover and Gay-Lussac towers, separating the central hall on each side from the wings. This arrangement was selected because of its convenient compactness and easy ventilation.

The plant consists of 16 units, each comprising three furnaces, one Glover tower, seven chambers totaling 3,150 cu.m., two Gay-Lussacs and numerous pumps and accessories. The large number of units is necessary to give the requisite flexibility due to fluctuating markets.

The principal characteristics of the installation are the

Motor and Compressor Floor





Pyrites Burners in Central Hall of Sulphuric Acid Plant

large Glover towers and the intensive chamber system. Through the arrangement of the furnaces in a double row, the pyrites can be carried on a single conveyor running through the middle of the hall and feeding both sides. Likewise the cinders are conveyed out by cars on an endless cable, the discharge in the rear of the furnace being automatic. These cars likewise dump the cinders on the grounds automatically. Nitric acid is distributed through alloy steel pumps and pipe lines.

This use of mechanical methods and the arrangement of the equipment have permitted a great reduction in manual labor, an essential condition in Holland, where it is scarce. The daily man-power required for the manufacture of 10 tons of 60-deg. sulphuric acid thus comes to: 0.9 for supervision; 0.2 for labor handling raw materials; 0.6 for ordinary maintenance and repairs.

With a view to manufacturing nitrates, a plant has been constructed for the production of 120 tons of 36-deg. nitric acid daily, consisting of a closed building in which are situated the ammonia oxidizing chambers, several compressors and absorption cylinders.

In the Fauser system employed here, absorption cylinders replace the customary towers filled with Raschig rings. The tanks are empty except for the nitric acid through which the gas bubbles for absorption. Because the tanks are cooled on the outside, the streams of acid flowing on the walls within are rapidly cooled, which favors both the oxidation and the absorption. They are arranged on a descending plane, the acid flowing down by gravity and the gas ascending countercurrently. The gas is thus constantly being washed by more dilute nitric acid. This arrangement also eliminates a considerable amount of pumping.

Under certain controlled conditions, a 40-deg. acid is obtained, which is valuable in the direct production of certain nitrates, especially ammonium nitrate. The average yield obtained in this process is about 92 per cent. The energy consumption runs about 60 kw.-hr. per ton of 36-deg. acid, but in consideration of power costs at Sluiskil and the reduction in manual labor, the economy is even more striking.

Because the enterprise is situated at some distance from any sizable town, it was necessary to construct habitations for the supervising and operating personnel. These houses, as well as other community construction, have been situated at a short distance from the plant and are intended to fulfill the demands of comfortable existence. The laborers' houses are situated in the immediate neighborhood of the plant.

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Intergranular Corrosion

At the recent meeting of the American Institute of Mining and Metallurgical Engineers, P. Payson, of the Crucible Steel Co. of America, stated that he has found that the addition of some elements in sufficient quantities to develop ferrite in the 18-chrome, 8-nickel steel, when rapidly cooled from 1,850 to 2,100 deg. F., made the steel highly resistant to intergranular attack. The alloy is highly resistant to this form of corrosion when it contains: (1) higher chromium than usual and about 3.3 Mo; (2) 20.8 Cr and 3.9 Si; (3) the usual analysis plus the addition of 0.7 Ti; and (4) 19.1 Cr and 1.88 V. The addition of 0.7 V to a steel with 19.3 Cr somewhat improves its resistance. Tungsten with slightly higher chromium than usual improves the resistance of the steel to intergranular corrosion but does not entirely prevent it.

A Graphical Method for

Determining Pressure Drop and Heat Transfer in Pipes

By R. A. BAYARD
Mechanical Engineer
Niagara Falls, N. Y.

ALMOST EVERY ENGINEER, operating man and designer alike, has frequent need to determine in advance the frictional pressure drop that is to be expected when some fluid with which he is concerned is to be forced or drawn through a pipe. There are at present a number of charts in use which supply this information, but generally it is given only for some particular fluid such as air, oil, water or steam. It was to provide a universal chart, suitable for any fluid, that the author developed the one reproduced on the opposite page. By its use, it is readily possible to draw a few straight lines and so determine the pressure drop for any fluid, either gas or liquid, and under conditions of flow that may be either viscous or turbulent. However, the chart is not limited to this one use. It also gives film heat-transfer coefficients for liquids; gives optimum size of pipe, taking into consideration both the cost of pipe and the cost of pumping; and provides a handy method for converting flow rate in one set of units into flow in another. Thus, lineal velocity in the pipe may be converted immediately to gallons per minute or to cubic feet per second. Conversely, quantity flow may be converted readily into velocity of flow. The chart also supplies equivalent values for specific gravity and density in pounds per cubic foot; gallons per minute and cubic feet per second; and pressure drop in pounds per square inch and inches of water. Finally, it gives the third quantity of specific gravity, kinematic viscosity and viscosity in centipoises when any two of these three quantities are known.

Frictional Pressure Drop

By the use of an equation based on Fanning's formula, it is possible to calculate the pressure drop in 100 ft. of straight, clean pipe when the pipe diameter, cubic feet per second flowing, and the density and viscosity of the fluid are known. This has been worked out for the chart by supplying the friction factor of Walker, Lewis and McAdams, and graphically solving the equation. The method of using the chart for this purpose is shown by the solid line, the arrows indicating the order in which to pass from one step to the next. In the following problem, what is the frictional pressure drop per 100 ft. of 2.5-in. steel pipe with a flow of 90 gal. of oil per minute? The oil has a specific gravity of 0.8 and a viscosity of 2.5 centipoises.

Nomenclature

(Symbols represent average values under the conditions of the problem).

C = Specific heat

k = Heat conductivity, B.t.u. per hour per square foot per deg. F. per foot of thickness

S = Specific gravity, water = 1.

Z = Viscosity in centipoises relative to water at 68 deg. F.

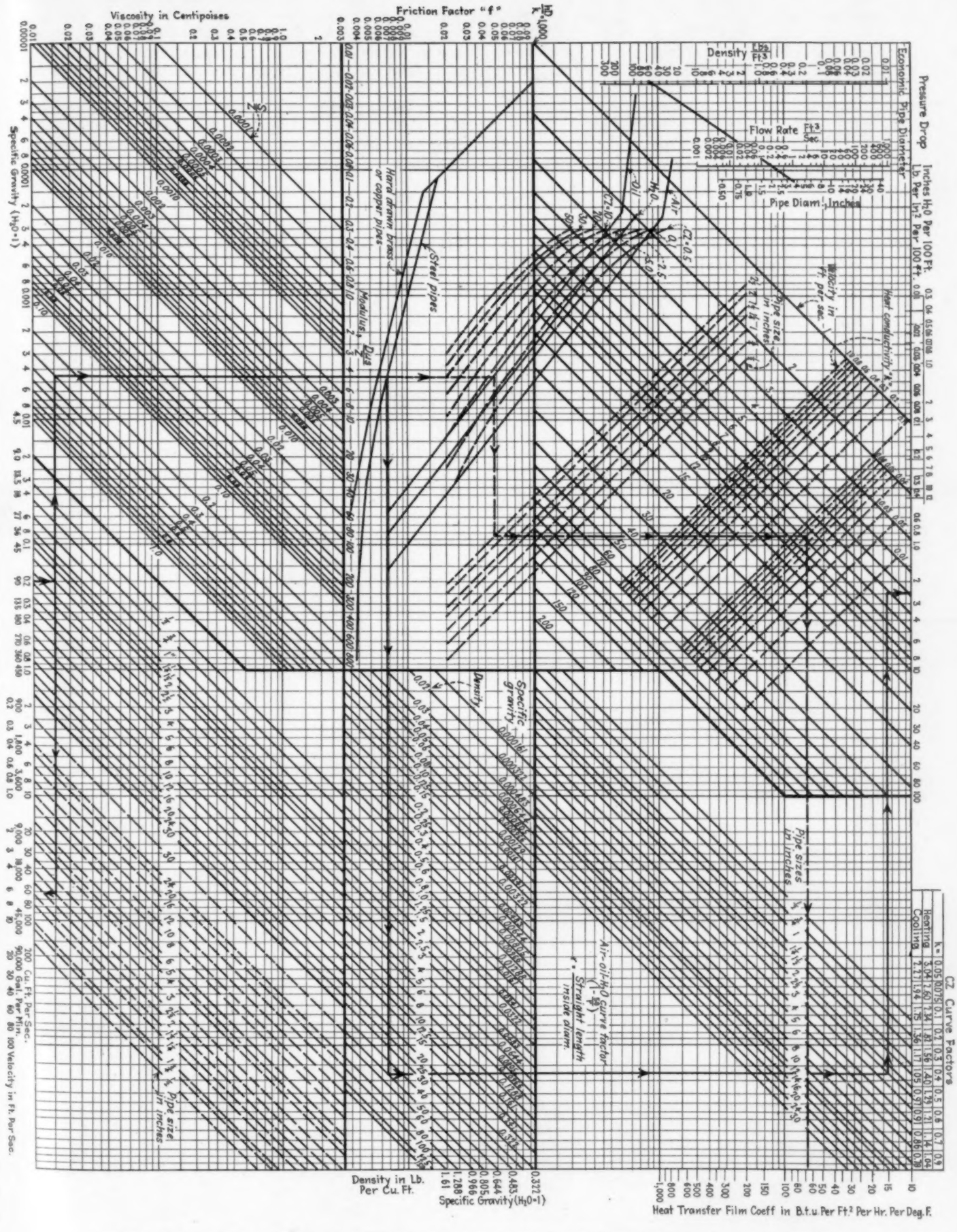
Procedure

1. Starting on the bottom line at 90 gal. per minute, rise vertically to meet the diagonal line for 2.5-in. pipe.
2. Go horizontally to the right to meet the dashed line for 2.5-in. pipe, then vertically downward to the base line. Read there the lineal velocity in the pipe, 6.2 ft. per second.
3. Extend the horizontal line to the left to meet the kinematic viscosity line, the quotient of S/Z (0.32). This line is the diagonal through the point of intersection of the vertical, specific-gravity line (0.8) and the horizontal, viscosity line (2.5). Or it is obtained by dividing S by Z.
4. Rise vertically to the friction curve for steel pipe.
5. Go horizontally to the right to meet the diagonal density line for a specific gravity of 0.8.
6. Rise vertically to meet the diagonal line for 2.5-in. pipe.
7. Go horizontally to the left to meet the diagonal velocity line. Its value, 6.02 ft. per second, was the one found in step (2).
8. To determine the final answer, rise vertically and read the pressure drop per 100 ft. of pipe on the top line. It is evident that the quantity sought is 2.4 lb. per square inch.

Drop through pipe fittings is calculated by taking for each fitting a length of straight pipe having an equivalent drop. This equivalent in feet is approximately the pipe diameter in inches multiplied by 2.75 for elbows, by 5 for tees and return bends, by 1 for gate valves, and by 7.5 for globe valves. For old pipes, allowance must be made for their inside condition. For this the tables of Hazen and Williams may be helpful. If pipe sizes in a line are abruptly changed, the contraction or expansion losses must be added to the sum of the drops in each size of pipe to get the total drop.

Optimum Pipe Size

The three vertical scales in the upper left corner of the chart, marked "Density," "Flow Rate" and "Pipe Diameter," are drawn so that a straight line through the



This Chart Solves Pressure-Drop and Heat-Transfer Problems for Any Fluid

fluid density and the flow rate in cubic feet per second will pass through the diameter of the most economical size of pipe to use. Calculations for this nomograph are based on the cost of pipe and pumping. If we take the previous example, the chart shows that for greatest economy a 3-in. pipe should be used instead of a 2.5-in. pipe.

Heat-Transfer Coefficients of Fluids in Pipes

In designing heat exchangers, it is important to know the pressure drop through the tubes as well as the heat-transfer coefficient. It is desirable to have the solutions to both problems on one chart so that the relation between pressure drop and heat-transfer coefficients may be seen at a glance. The heat-transfer chart uses the same base line as the pressure-drop chart. This can be done because both are functions of the Reynolds number.

The heat transfer curves marked "Air," "Water" and "Oil" are the straight-line curves of Walker, Lewis and McAdams. The CZ curves, which are used for any liquid, are based on later data and are not plotted for specific temperatures as are the others. They make use of the relation Morris and Whitman found between the Reynolds number and the film coefficient.

The method of using the chart for the air, oil and water curves in solving for the heat-transfer coefficient is shown by the arrowed, dotted lines. The conditions of the problem are the same as those postulated for the pressure-drop solution given above. In addition, it is assumed that the heat conductivity coefficient, k, is 0.8.

Procedure

1. Same as step (1) for pressure drop.
2. Omitted
3. Same as step (3) for pressure drop
4. From the kinematic-viscosity line, S/Z, rise vertically to meet the oil line insted of stopping at the friction curve as in the pressure-drop problem. The heat-transfer lines are readily distinguished from the pressure-drop lines by being slanted in the opposite direction.
5. Go horizontally to the right to meet the dashed line for 2.5-in. pipe.
6. Rise vertically to the heat conductivity line for k=0.8.
7. Go horizontally to the right and read the film coefficient, 68, on the right-hand vertical scale.
8. For obtaining the corrected value, multiply by the factor $(1+50/r)$ where r is the ratio of the length of straight pipe to its actual inside diameter. For example, in the present problem, the coefficient read is 68. If the length of straight pipe is 18 ft., the correction factor is

$$1 + \frac{50}{18 \times 12 \div 2.47} = 1.57$$

Hence, $68 \times 1.57 = 107$, which is the corrected value of the coefficient.

For fluids other than air, water and oil, the procedure is the same as that described above except that in step (4), our dotted line rises to the appropriate CZ curve. For example, if the specific heat of the oil is taken as 0.5 and the viscosity as 2.5, CZ is equal to $0.5 \times 2.5 = 1.25$. Rise, then, from the S/Z line to meet the $(CZ = 1.25)$ curve (interpolated). Then go to the right to the pipe-size line and follow through the remaining steps to read the coefficient on the right-hand scale. For the corrected coefficient, multiply by a factor obtained from the table in the upper right corner of the chart. The proper value depends on k and is chosen for either heating or cooling, as the case may be. In this example, the coefficient is 58 and the factor for cooling, interpolated from the table for $k = 0.08$, is 1.79. Hence, the corrected coefficient is 104 B.t.u. per hour per square foot per degree F.

The solution of these problems by straight, zigzagging, horizontal and vertical lines on the chart is simple and, after the chart has been used a few times, will be found to become a quick routine.

▼ ▼ ▼

Frictional Pressure Drop in Rubber-Lined Hose

EXPERIMENTS recently carried out by development engineers of the mechanical rubber goods division, B. F. Goodrich Rubber Co., has resulted in the derivation of a table for the frictional pressure drop encountered in the flow of water through rubber-lined hose and pipe. So far as is known, this is the first time these data have been available.

The work consisted in determining for flow in contact with smooth rubber surfaces the value of C to be used in the formula of Hazen and Williams. This formula is:

$$V = 1.318CR^{0.63}S^{0.54}$$

Where V = Water velocity in the pipe, feet per second
C = An experimental constant depending on the type of hydraulic surface
R = Hydraulic radius = area of wetted cross-section ÷ circumference of wetted cross-section
S = Slope of the hydraulic grade line = pressure head in feet ÷ total length of the horizontal projection of the pipe in feet

For iron pipe, the value of C ranges from 100 for new pipe to about 140 for pipe that has been in service for some time. It was found that the value for smooth-bore rubber hose, whether mandrel-cured or not, is approximately 140, and that this value remains constant during service. Using this value, the table below has been computed to give pressure drop per 100 ft. of hose.

Pressure Drop for Water in Rubber-Lined Hose and Pipe
(Taking C = 140 in the Hazen and Williams formula)

U. S. Gallons per Minute	Pressure Loss, Pounds per Square Inch per 100 Ft. — Actual Internal Diameter of Hose, Inches										
	½	¾	1	1¼	1½	2	2½	3	4	5
½	0.5	....	....	....	....	....	....	....	....	....	....
1	2.8	0.7	0.5	....	....	....	....	....	....	....	....
2	7.6	2.1	1.1	....	....	....	....	....	....	....	....
5	28.5	9.6	4.0	1.1	0.4	0.2	....	....	....	....	....
10	101.0	33.8	14.0	4.0	1.2	0.5	0.2	....	....	....	....
15	....	70.0	30.0	8.9	2.5	1.1	0.4	0.1	....	....	....
20	....	112.0	53.0	14.0	4.3	1.8	0.7	0.2	..	....	....
25	....	....	79.0	22.0	6.5	2.9	1.0	0.3	....	....	....
30	....	....	112.0	31.0	9.2	4.0	1.4	0.4	0.1	....	....
35	....	....	147.0	41.0	12.0	5.3	1.8	0.5	0.2	....	....
40	....	....	....	53.0	15.0	6.7	2.4	0.6	0.3	....	....
45	....	....	....	66.0	19.0	8.4	3.0	0.8	0.4	....	....
50	....	....	....	80.0	24.0	10.0	3.6	1.0	0.5	....	....
60	....	....	....	101.0	35.0	14.0	5.1	1.4	0.6	....	....
70	....	....	....	....	45.0	19.0	6.6	1.8	0.8	....	....
80	....	....	....	....	58.0	24.0	8.6	2.3	1.1	....	....
90	....	....	....	....	71.0	30.0	11.0	3.0	1.4	0.3	....
100	....	....	....	....	88.0	37.0	12.5	3.5	1.7	0.4	0.1
125	....	....	....	....	132.0	55.0	20.0	5.3	2.5	0.6	0.2
150	....	....	....	....	183.0	78.0	27.0	7.5	3.5	0.7	0.3
175	....	....	....	....	....	100.0	37.0	10.0	4.6	1.1	0.4
200	....	....	....	....	....	133.0	46.0	13.0	5.9	1.4	0.5
250	....	....	....	....	....	....	70.0	19.0	9.1	2.1	0.7
300	....	....	....	....	....	....	95.0	27.0	12.0	2.9	1.0
350	....	....	....	....	....	....	126.0	36.0	17.0	4.0	1.3
400	....	....	....	....	....	....	....	46.0	21.0	5.1	1.7
450	....	....	....	....	....	....	....	57.0	26.0	6.3	2.1
500	....	....	....	....	....	....	....	70.0	32.0	7.4	2.6
1,000	....	....	....	....	....	....	....	....	116.0	27.0	9.6
2,000	....	....	....	....	....	....	....	....	....	100.0	32.0

Application of Vacuum Cooling to Continuous Crystallizers

By H. B. CALDWELL

General Manager
Swenson Evaporator Co.
Harvey, Ill.

APPLYING VACUUM cooling to crystallizing apparatus is not an entirely new idea, as it has been used in one stage or another of its development for years, principally in the potash industry of Europe, and more recently, in the Searles Lake potash operations in California. Its application in such plants is quite logical and it is not surprising that they were among the first to adapt vacuum crystallization to regular plant production, as they have unusually large quantities of solution that must be cooled economically. In this rôle, the vacuum crystallizer stands paramount in the list of all mechanical, artificially cooled devices. Foremost among its capabilities is the fact that it is not necessarily limited by the temperature of the available cooling medium. The final temperature of the cooled solution may be either higher or lower than the temperature of the cooling water available for the condenser. A realization of these facts has, for several years past, prompted an interest in vacuum crystallization on the part of the writer and the Swenson Evaporator Co.

Before some of the interesting applications and operating characteristics of vacuum crystallizers are discussed, a glance at Fig. 1 will show the general design and principle of operation of a single stage. The body is a vertical, cylindrical shell of sufficient height to provide ample vapor space above the solution level. The hot solution is fed in continuously and the cooled solution is continuously removed with the crystals in suspension. The cooling is effected by maintaining the desired vacuum in the vapor space, thus permitting the feed solution to flash off vapor until its temperature is in equilibrium with the vacuum maintained. Thus with 60-deg. F. cooling water available, a vacuum of 29 in. of mercury, referred to a 30-in. barometer, can be maintained. This will cool water to 80 deg. F. However, if the solution to be cooled has a boiling-point elevation of 5 deg. F. at 29 in. vacuum, it will be cooled to 85 deg. F.

From this description of the operation, it is immediately apparent that the vacuum crystallizer has no wall through which heat is transferred to the cooling medium from the liquor to be cooled. In this fact lie many of the virtues of this type of crystallizer: no cooling surfaces to "salt up," thus decreasing the rate of heat transfer and capacity; no scraper mechanism for the cooling surface; and no cooling water jackets or coils to corrode or become scaled from unfavorable cooling-water conditions. Moreover, the initial cost is only a fraction of that for the other types of artificially cooled crystallizers, since the capacity of a given body is limited only by the vapor velocity and not by the number of square feet of cooling surface that would be obtainable with a jacket or coils.

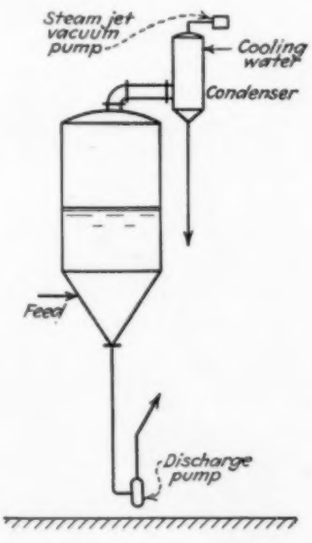


Fig. 1—Single-Stage Vacuum Crystallizer Without Compressor

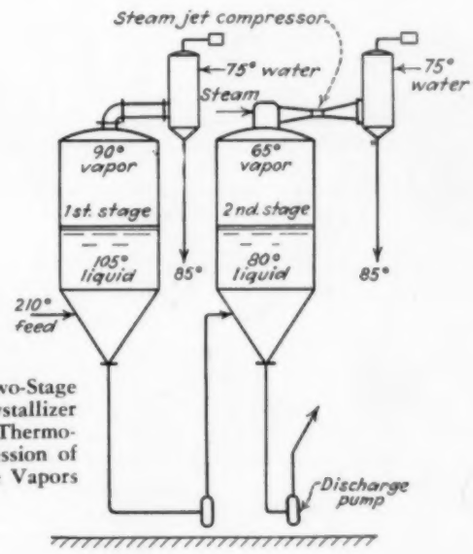


Fig. 2—Two-Stage Vacuum Crystallizer With Thermo-Compression of Second-Stage Vapors

This latter advantage is considerably increased if the solutions are corrosive toward ordinary, low-priced materials of construction such as cast iron or steel. Perhaps Stainless steel, Monel metal, copper, or lead might be indicated for certain solutions if a design of crystallizer using a metal wall for the transfer of heat were to be employed. However, with the vacuum crystallizer, many of these same solutions can be handled satisfactorily in rubber-lined steel bodies with their attendant low cost.

Let us now suppose that we still have 60-deg. F.

cooling water available, but that we want to cool a solution with a 5-deg. F. boiling-point elevation to 50 deg. F. Under these conditions, the 45-deg. F. vapor cannot be condensed by the 60-deg. F. cooling water, therefore, a compressor is inserted in the vapor line between the body of the crystallizer and the condenser. The vapor is compressed to a pressure and temperature at which the 60-deg. F. cooling water readily condenses it. The compressor used is of the steam jet type, as also are the

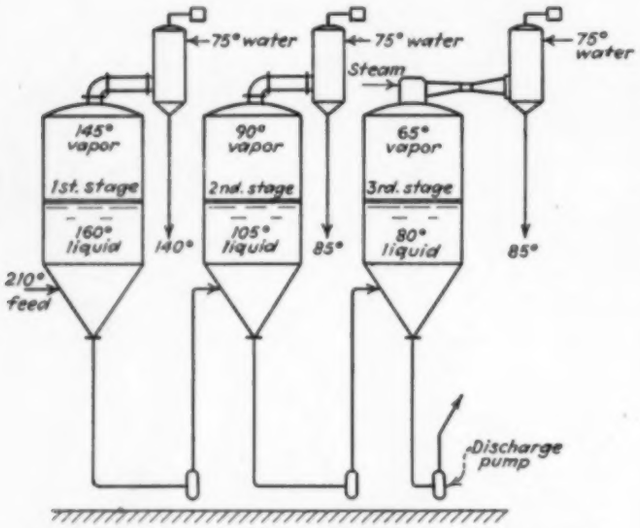


Fig. 3—Three-Stage Crystallizer Uses Less Cooling Water Than a Two-Stage Machine

vacuum pumps in most cases. With this type of vapor-handling equipment, temperatures around the freezing point of water are easily maintained in commercial practice, even with cast-iron bodies having bolted joints.

We have in the vacuum crystallizer, therefore, a means of obtaining temperatures considerably lower than the available cooling water. However, in considering a vacuum crystallizer for low-temperature cooling of solutions with high boiling point elevations, we may run into an impractical condition on account of the abnormally low vapor temperatures encountered. Suffice it to say that the steam and cooling water consumption increases as the temperature decreases.

For a definite set of conditions, we arrive at a critical temperature, above which vacuum cooling requires less energy and below which brine cooling from an ordinary ice machine requires less energy. However, this critical point is not the temperature where it is advisable to shift from one system to the other for the sake of economical operation. The actual shifting point is a somewhat lower temperature, as the initial cost and maintenance of a brine-cooled crystallizer, with its ice machine, is considerably greater than the vacuum crystallizer with its steam-jet compressor.

The actual design of a vacuum crystallizer body is somewhat more involved than is apparent when first considered. One of the greatest disadvantages of the vacuum crystallizer in the past has been the salting-up of the body, feed inlet, circulation piping, and other parts. The tendency of the early European designs was to employ very large diameter bodies, into the upper part of which the feed was sprayed, with the hope that the flashing off of vapor would be complete before the droplets touched the body wall. This was, in part, successful, as the surface of the body below the solution level remained relatively free from crystals for several days; but the upper part of the body become rapidly coated, due to the partially cooled spray which was carried into contact with it. Also, the partial flashing of the feed in the spray nozzles rapidly salted them up, with the result that frequent washing of the nozzles was necessary. Another inherent fault of this design was the very small crystal size produced. However, the vacuum crystallizer, such as it was, gave practically continuous operation between body washouts, and it was enthusiastically received as a marked improvement over all former methods.

A later design used in the United States employed a means of thermal circulation by providing two dependent legs from the body, connected at their lower ends. Into the lower end of one of these legs the hot feed was introduced, producing a rising current, the velocity of which increased due to flashing as the hot solution moved upward, thus progressively eliminating hydrostatic head and increasing flashing until equilibrium conditions were reached. Through the other leg the cooled solution descended and at its lower end the discharge was withdrawn. This design improved the size of crystals and, by imposing sufficient hydrostatic head at the point of feed, overcame flashing and salting-up of the feed line. However, as vapor was flashed off all the way up the feed leg and also in the body, these parts were subject to salting-up which necessitated frequent washouts.

Probably the most recent improvement has been the use of artificial circulation, which effectively prevents the salting-up of all parts of the equipment, thereby providing truly continuous operation. This method has simultaneously increased crystal size to the point where it compares favorably with the product from continuous crystallizers of the heat-transfer type.

There is another point of interest in the design of the vacuum crystallizer body where submerged feed is used. This is known as "short-circuiting," which can be said to occur when the temperature of the discharge solution is higher than that expected from the prevailing vapor pressure. There are three possible causes of this: The first, which is the most obvious, is the ordinary mechanical short-circuiting of the hot feed to the discharge. This is of no importance, as it can be overcome in any one of many different ways. The second is the effect of hydrostatic head: If every particle of the feed liquor does not reach the exact surface of the solution before being discharged, it will never be cooled to the temperature in equilibrium with the vapor. The third cause is found in the greater or lesser tendency of a particular solution to supersaturate. Even if a particle of feed solution does reach the exact surface of the body of solution but does not remain there long enough to crystallize after being cooled, the heat of crystallization is liberated at some point under more or less hydrostatic head and thus part of the heat of crystallization is carried out with the discharge.

As an example of the havoc that hydrostatic head can play, let us go back to the case of cooling a solution having a 5-deg. F. boiling-point elevation to 50 deg. F. The 45-deg. F. vapor will have an absolute pressure of 0.3 in. of mercury. Assume that a given particle of feed will rise to within 12 in. of the surface of the solution, which has a density of 1.25. This 12 in. of solution will exert an extra pressure of 1.1 in. of mercury, thus giving a total pressure of 1.4 in., which corresponds to a temperature of 89.5 deg. F. Adding to this the boiling point elevation of 5 deg. F., we find that the little particle which

undershot its mark by 12 in. will travel out of the crystallizer at 94.5 deg. F. instead of 50 deg. F. Of course, as the temperature level at which the crystallizer is operating is increased, this hydrostatic-head feature becomes less important. The supersaturation effect is likewise a bad actor, but usually it is not of such magnitude as the difficulty arising from the former effect.

The degree to which these short-circuiting causes are overcome can be considered as a measure of the efficiency of a vacuum crystallizer, and the cost of operation, especially at low temperature levels, is greatly influenced by the design.

Thus far we have considered some of the fundamental features of one vacuum crystallizer body operating as a single-stage cooler. A single stage is, generally speaking, sufficient and economical in operation for problems of small magnitude, but for cooling large volumes of solution, particularly over wide temperature ranges, the operation becomes more economical if it is broken up into two or more stages. To illustrate some of the possibilities, three examples are given below. These will all assume a feed temperature of 210 deg. F., cooling to 80 deg. F. with 75-deg. F. cooling water. The solution will be assumed to have a 15-deg. F. boiling-point elevation at all pressures. Actually, the boiling-point elevation decreases with decreasing vapor pressures, but for the sake of comparison and simplicity it is assumed constant.

In Fig. 2 we have divided the cooling into two stages, the first stage carrying the temperature as low as possible with the 75-deg. cooling water and without the help of a compressor in the vapor line. The second stage completes the cooling with the aid of the compressor. In all these arrangements, it is advisable to cool as far as possible without the compressor, as the compressor is a large steam consumer. In this case we have cooled the solution in the first stage from 210 deg. F. to 105 deg. F., or 81 per cent of the total. It will be noted, however, that the rise in temperature of the cooling water is limited to 10 deg. F. to accomplish this.

In Fig. 3 we have divided the former first stage into two stages for the sake of reducing the quantity of cooling water required. In this case we are doing 38.5 per cent of the cooling with a 65-deg. F. rise in the condenser water in the first stage; and 42.5 per cent of the cooling in the second stage with the 10-deg. F. rise in condenser water temperature. Thus, we have used only 60 per cent as much water in this first and second stage as we used in the former first stage to do the same amount of cooling. The steam consumptions in both cases remain practically the same.

In Fig. 4 we have assumed that the mother liquor from the finally cooled solution is required back in the process at an elevated temperature; also that it is present in sufficient quantity to use as the cooling medium in one stage. With its temperature of 80 deg. F., it is logical to use it in the first stage and do as much cooling with it as possible. In the second stage, as before, we cool to as low a temperature as possible with the water available, but without using a compressor. The third stage completes the cooling as in the former case.

Should the mother liquor have been available at 60 deg. F. instead of 80 deg. F., it would have proved more economical to use it in the second stage instead of the first.

These arrangements serve to show the almost infinite variations that can be used. By changing the magnitude or conditions of cooling in any one stage, it is always possible to use more water and less steam, or vice versa; therefore, it becomes of considerable economic advantage to study carefully the various arrangements in the light of the respective costs of steam and cooling water. Surface condensers may be used in place of those of the countercurrent barometric type shown in the examples. With these it is possible to separate the condensed vapor flashed off from the cooled solution. The higher the pressure of steam available for the steam-jet compressors

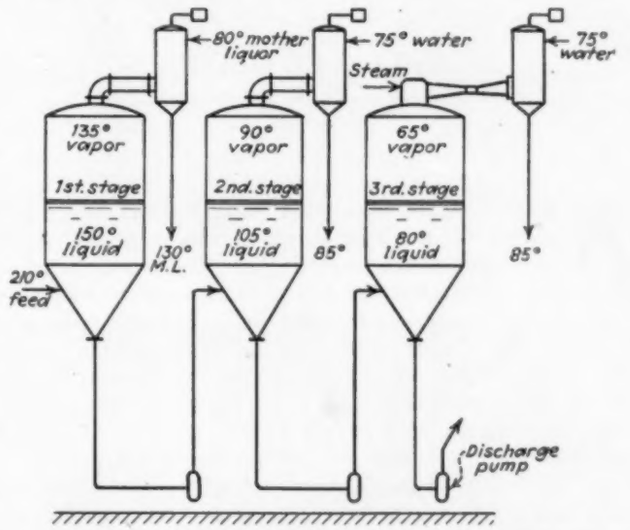


Fig. 4—Where the Cooled Mother Liquor From Stage 3 Must Be Heated, It Is Profitably Used as the Cooling Medium of the First Stage

and vacuum pumps, the smaller the quantity required. Steam of at least 90 to 100 lb. per square inch gage pressure is almost imperative. Superheated steam is of no advantage. As a matter of fact, it unnecessarily increases the quantity of cooling water required. Recent improvements in the design of steam-jet vapor-handling equipment have greatly contributed to the economy which the vacuum crystallizer possesses today.

Introduction of air or an inert gas into a vacuum cooler is an interesting possibility for decreasing the high vacuum required to give a certain temperature. The effect is to decrease the partial pressure of the water vapor in the vapor space for a given total pressure. However, this imposes an additional burden on the compressor or vacuum pump.

Another scheme of some promise is the use of a cooling medium with a high boiling-point elevation, in the countercurrent barometric-type condenser. If, for example, a solution of caustic soda or calcium chloride having a 25-deg. F. boiling-point elevation be used at 75 deg. F., with a 10-deg. F. rise through the condenser, vapor of 70 deg. F. can be condensed by it. Of course, the condensing medium is diluted and must be reconcentrated and cooled before re-use. This reconcentration and cooling is theoretically possible with less expenditure of energy than the use of a steam-jet compressor would entail. However, as far as the writer knows, neither of the last two schemes mentioned has been used in practice.

Before we leave this general subject, it will be interesting to note still another application of the vacuum cooler or crystallizer, which is the control of temperature in chemical reactions taking place in solutions where heat is evolved. The heat of reaction is dissipated in the vapor flashed off and, depending upon the vacuum maintained, the temperature remains at a corresponding point.

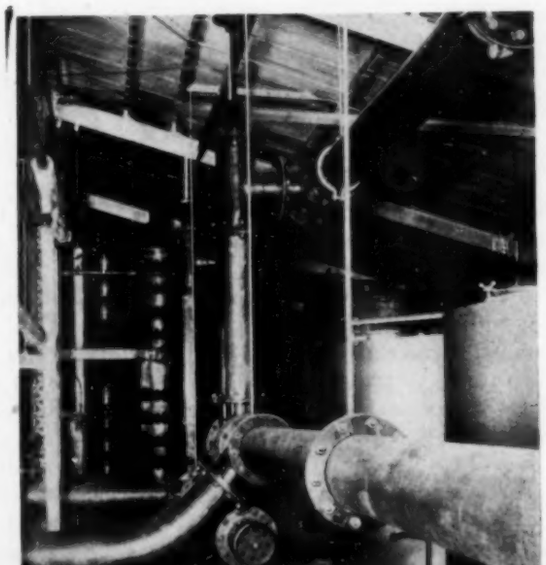
Guarding Against Corrosion in

ACETIC ACID EQUIPMENT

By D. F. OTHMER
Consulting Chemical Engineer
Rochester, N. Y.

ACETIC ACID appears in many rôles on many stages of modern chemical industry, and each requires a different setting of special equipment to withstand the destructive effect of this active material. The direct synthesis of acetic acid, starting from the basic materials, coal, lime, water and air, accounts, with the vigor of its comparative youth, for most of the increasing production. The fermentation method is older than Methuselah and dates back almost to his time, but it is yet in a ripe maturity and promises to give birth to lusty twins, acetic acid and its homologue, propionic acid, in a process now in commercial development. The wood distillation method, although it may now be suffering from a relapse, will continue to thrive for many years, since, as in the case of Mark Twain, the reports of its death have been much exaggerated. It is not beyond the realm of possibility that it will even be rejuvenated. And when the market becomes less competitive than it is at present, it is likely that still other acetic acid sources will be tapped.

Materials of construction for equipment used in processing, transporting, and handling the acid liquids encountered in these production processes, and in the numerous operations where acetic enters as a raw material, must be carefully chosen, taking into consideration the strength of acid and, especially, the other materials in solution besides water—even though these impurities may be present only in very small quantities. Different ranges of acetic acid concentration have widely different corrosive actions on metals and the presence of even a fraction of a per cent of other acids or their salts may increase the destructive action a hundredfold.



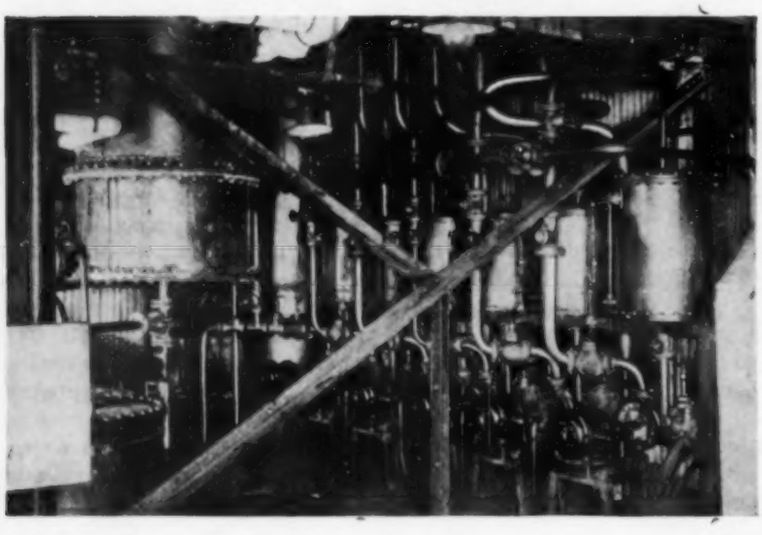
Large Acetic-Acid Piping With Acid Column in Rear

In addition to the number of different materials of construction which are necessarily used because of the different aspects of the corrosion problem, each different industry—and especially is this true of the older ones—has developed its own methods independently of the others, and by a process of growth and heritage has established its own preferences and standards.

Quite aside from the corrosive attack of acetic acid on metals, the solvent action of this versatile liquid on various other materials of construction is of importance. Acetic acid, especially when it is anhydrous or nearly so, is a solvent comparable to alcohol, ether or acetone. Like them, and particularly when it is heated, it may dissolve or disintegrate packing materials, wood, and other fibrous or plastic bodies that may be used in equipment construction. Anhydrous acetic acid, especially when it is hot, is flammable, as are most other solvent liquids.

The oldest methods for the production of acetic acid are those of the fermentation industries; and these follow the lead and use the ancestral methods and equipment of that parent of chemical commerce, the manu-

Assembly of Pipes and Float Regulators Controlling Large Wood-Distillation, Direct-Acetic Plant



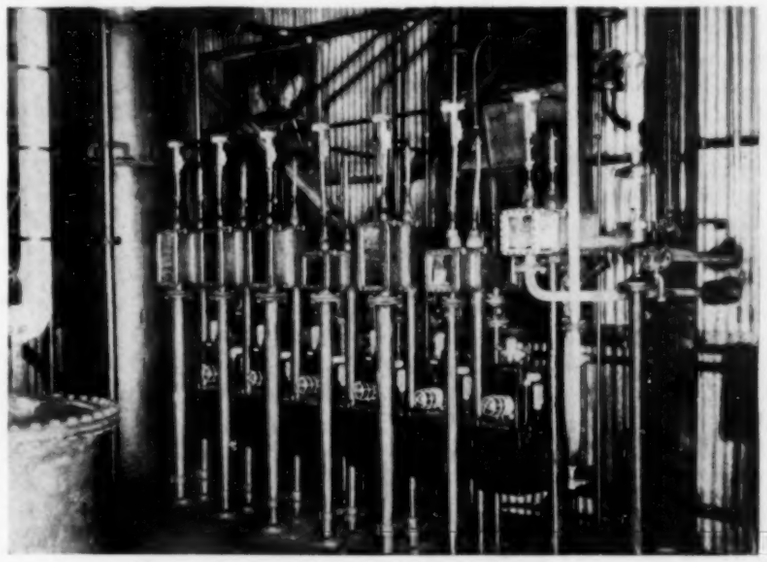
facture of alcohol. Tight wooden barrels and kegs for shipment, wooden tanks for cold processing and storage, and wooden pipe lines for conveying, are traditional. For dilute organic acids, such as are found in apple cider and vinegar, in many ways no better pipe can be found than the old "log lines" drilled from solid and selected straight-grain timbers. The pipe lengths have fitted ends which depend for their tightness—like barrels, stave tanks, and wooden boats—on the swelling of the wood when wet; and these pipes are attached by socket connections which swell to a sound joint. The elbows and tees, likewise, are formed by drilling blocks of wood. Wooden stave construction of pipe lines as well as tanks is suitable where higher pressures or larger quantities are encountered than can be handled in bored log pipe, and piping so constructed may be installed in a single built-up length. Either the drilled or stave lines, when reinforced with wire windings, may be used for pressures up to 100 lb. per square inch in moderate-sized pipe.

Besides the cheapness of wood, and the ease of fabrication and making joints, an important advantage is the thermal insulating properties of this natural resistor to the flow of heat. This is a consideration for tanks and pipes both in protecting against freezing in cold climates and in preventing heating of the liquid in some processes where refrigerated acid is handled. Wooden equipment is not usually used with hot acetic. In acid concentrations above 25 per cent, the disintegration and shrinking of wood is rapidly accomplished by hot acid and, in some cases, by cold acid. Wooden pipes, tanks and tank cars used with anhydrous acid will develop leaks on account of the shrinkage of the staves caused by the acid's absorbing moisture from the wood.

Rubber hose has an extensive use in handling vinegar between pumps, tanks, filters and other equipment. It is not usually installed permanently, but is moved from place to place as needed. It has an excellent length of life with vinegar at any temperature normally encountered. Acidproof hose is made in sizes up to 10 or 12 in. in diameter. Hard-rubber pipe and fittings also are used in special applications, such as in heads for measuring, controlling and distributing liquid flow to the vinegar generators. But because of the brittleness, thermal expansion, and comparative difficulty of installation of hard-rubber pipe, rubber hose is to be preferred wherever a rigid tubing is not necessary. Hard- and soft-rubber-lined wood and steel containers also have been used for storage, processing and transportation of solutions of acetic acid of intermediate strength.

Rubber diaphragm or "pinch" valves are in use with cold acetic acid on low-pressure pipe lines of various metals. These valves consist essentially of a short length of specially shaped soft-rubber tubing incased in a metal body. The construction requires no packing box, since the action in closing the valve consists simply in squeezing the two walls of the tubing together as in pinching a small rubber tube with the fingers or a small pinch clamp. The operation, however, is on a greatly magnified scale, since these valves are used in sizes up to several inches in diameter.

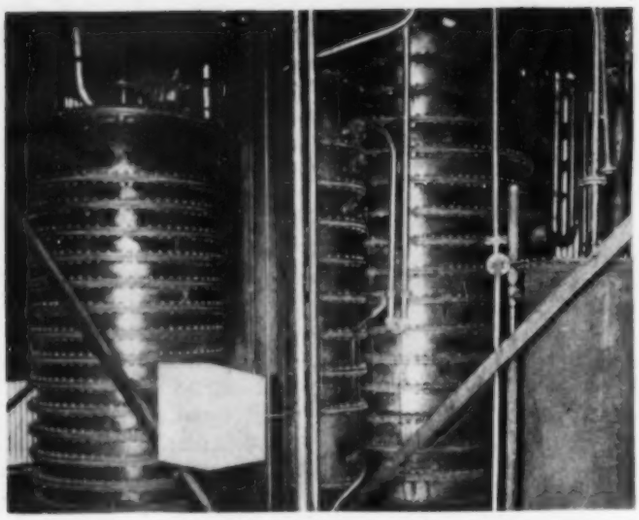
Besides these two non-metallic materials, wood and rubber, the vinegar industry has used, and to some extent now uses, equipment of iron, brass, copper, nickel, Monel metal, tin and the various chrome-iron and chrome-nickel-iron alloys. Wrought iron and mild steel do not have a satisfactory life with vinegar or other fruit or fermentation acids; brass, copper and bronze, while still in use, are objectionable in that with heated dilute acetic acid, especially, they offer the danger of forming poisonous copper acetate, or verdigris; and Monel metal, nickel and solid tin have been too expensive for ordinary use, but are used for short pipe and for heating tubes, valves and specialties. Monel metal and nickel form no poisonous compounds and have a much better life than brass with dilute acid, but do not last as well as silver, which occasionally has been used, usually in the form of silver plate over copper. Most promise is indicated by some of the newer high-chrome-nickel steels of the 18-8 variety which have been used in equipment for the processing of hot vinegar for over a year without sign of corrosion.



Tail Box Station in Wood Distillation Plant Showing Aluminum Piping and Weir Box for Refined Acid

In the wood distillation industry, the standard material for processing all strengths of acetic acid below the anhydrous grade is copper. Although aluminum might otherwise be used in some places, the presence of formic acid, which is nearly always in evidence as an impurity in wood distillation acids, would rapidly destroy equipment of this material. In some cases, the protective action of a film or layer of tar, settling from the pyroligneous acid on the inner surface of tanks, so reduces the corrosive action that cast iron or steel may be satisfactory.

Copper—In the smaller sizes, copper pipe is made up with standard threads and cast copper or bronze fittings, and in sizes above 3 in., of seamless copper tubing with Van Stone flanges made up on the job. Such joints have cast-iron or mild-steel backing flanges. Another type of copper piping has been used experimentally and found to have several advantages in smaller-sized lines. This is the compression fitting type which utilizes soft copper tubing supplied in rolls. By the use of a special flaring tool, the tubing may be slightly belled at its ends, and the lengths connected with copper or bronze fittings which produce a tight metal-



Acetic Acid Dehydrating Columns Showing Heavy Copper Construction

to-metal joint not unlike that employed in gasoline piping for automobiles.

It is becoming the practice to fabricate copper distillation and other equipment by welding deoxidized copper sheet and tubing. The welding of pressure vessels of sheet up to ½ in. in thickness has been successfully accomplished. Forged copper elbows, reducers and ends are available for pipe lines and are welded or brazed in place in the same way, and in the usual case, with the same standards as have recently been developed for the welding of steel pipe lines. Pipe lines utilizing as much as several miles of copper pipe are to be found so constructed.

For those strengths of acetic acid higher in acid than vinegar or pyroligneous acid, and including the liquids encountered in the synthesis from calcium carbide and acetaldehyde, the usual material of construction is copper. Copper is used whenever possible for equipment which may be fabricated from plates, because of its large advantage of easy working. Copper has a very satisfactory life at all strengths and temperatures of acetic acid if the liquid is free of dissolved air or oxygen. The acetic acid corrosion of copper distillation units which are protected against the presence of air by continuous operation and other precautions is practically nil.

Vent lines, however, although they are not in contact with heated vapors or liquids, may have to be replaced on account of attack by the small quantity of comparatively cold acid vapor which passes through them, mixed with a much larger quantity of air. Such copper distillation units will not discharge a water-white acid until all of the air in the system has been eliminated, prior to which time they pass an acid colored with blue copper acetate, first of an inky blue, and then, as the air is gradually removed, of lighter and lighter tints. Recovery systems which involve the condensing of acetic acid vapor from air are rapidly destroyed if constructed of copper, due to this oxidizing action. The thin expanded metal of finned copper tubes, when used for condensing vapors from air, is corroded to so fragile a skeleton of verdigris that it may easily be crumbled by a blast of air or a slight vibration.

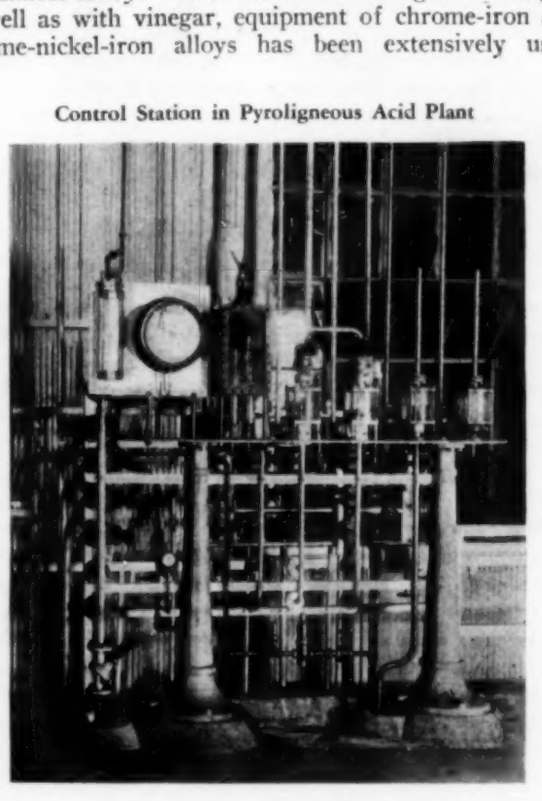
Silver has even better resistance to acetic acid than copper; and at the same time, it is relatively unaffected by the presence of oxygen. Like copper, it is readily workable, but its cost has kept it from extensive use, except for small specialties. Copper vessels and tubing have been successfully silver plated to give almost perfect resistance to hot acid vapors mixed with air.

Copper Alloys—Because of its cheapness and ready availability, brass is used in handling much acetic acid of various strengths, even though it is not usually the best material for the purpose. Probably the range of acetic acid concentrations which has the most corrosive action on most metals is that from 35 to 40 per cent; and hot acetic acid of such concentrations, containing considerable air in solution, has practically destroyed brass pipe lines in two weeks' service in cases where better materials were not immediately available. Aluminum-bronze castings have been used to a considerable tonnage in acetic acid applications. On the whole, the results have been very satisfactory. Large distilling-column plates, as well as pumps for handling up to 2,000 gal. per minute, have been made of this material. Cast aluminum-bronze pipe has been available for use with acetic acid, but as far as this writer knows, it has not enjoyed any large usage. The porous nature of castings improperly made of this material has, on occasion, been disastrous. In an extreme case a pump impeller lost over 50 per cent of its weight in a month's operation. When replaced with Duriron, the pump showed no effect after a year's service.

Duriron is practically unaffected by acetic acid at any temperature or concentration, even in the presence of oxygen. It has been used under severe conditions in pipe lines of considerable length, and in large digestors, pumps and other equipment. Duriron units, correctly installed, have an almost unlimited length of life with acetic acid liquids containing any of the impurities normally encountered. The development of a somewhat stronger and less brittle Duriron in recent years has greatly increased its usefulness. It is often the practice to use Duriron valves in diameters up to 4 in., even when the line itself is constructed of copper with flanged ends. Such valves are comparatively cheap and, as Duriron is very hard, are not affected by "wiredrawing."

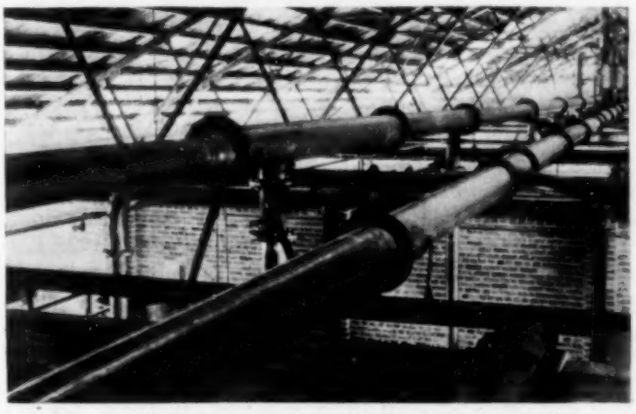
Stainless Alloys—With acids above vinegar in strength, as well as with vinegar, equipment of chrome-iron and chrome-nickel-iron alloys has been extensively used.

Control Station in Pyroligneous Acid Plant



Before a suitable technique for their welding had been developed, considerable trouble and danger to workmen was encountered through cracking and occasional complete severance across the weld after it had been in service for some time. The present practice of using stainless alloys of low carbon content, and the improved technique of welding, have removed the danger of such failures. One company is replacing a very large distilling system for strong acid handling with columns, piping and fittings of an 18-8 steel.

Lead—The use of lead as a material of construction for equipment for other acids than acetic has been very widespread. Because of its poor mechanical properties, lack of strength, and high density, as well as its comparatively poor resistance to acetic acid, lead has had only very limited application in this field. Even such traditional uses of lead as laboratory or washing sinks are often usurped by copper in acetic plants.



Copper Ducts Over Wood Distilling Retorts, With Gas Scrubber in Rear

Bonded Metals — One installation, in which it was necessary to have combustion gases in direct contact with tubes containing acetic acid vapor under pressure, was designed with a double tubing having a nickel tube drawn over and fitted so tightly to a central copper tube that separation was impossible. The inner copper tube which carried the vapors was reinforced against the internal pressure and protected against the oxidizing effects of the stack gases by the nickel sleeve. A somewhat similar construction involves an actual bond between the metals and is now available for tubing and vessels produced from plates. Either the inner or outer layer of the vessel is made of a relatively thin ply of acid-resisting chrome-nickel steel; of pure nickel; or, for other uses than with acetic acid, of lead. In any event, the thicker, reinforcing metal layer generally is ordinary mild steel.

Tantalum, a metal so difficult to produce that its very name recalls the struggle of metallurgists for its mastery, has an almost perfect resistance to acetic acid under all conditions, even when it is contaminated with any of the impurities encountered in technology. Although this metal probably will continue to have a limited usefulness because of its cost, it is nevertheless being considered for lining reaction vessels processing acetic acid. It has already been used for lining tubing carrying other corrosive acids. An arduous task has been the development of methods of making it available in a thin coating on the surface of cheaper metals capable of supplying mechanical form and strength. This metal, strong, ductile and chemically inert, is rolled into sheets a few thousandths of an inch thick; formed into tubes, which are electrically welded down an almost perfect seam; and hydraulically stretched to line snugly the inside of heavy-walled tubing of baser and cheaper metal.

Tantalum itself, because of the very difficulty of dissolving it, has resisted attempts to deposit it by electroplating. Instead of the usual method of making a corrosion-resisting film of one metal on another by deposition of the resistant material, with tantalum the process is reversed. A thin covering sheet of tantalum is made first in the desired shape; then a cheaper metal, such as copper, is heavily plated on one side or another until the desired thickness and strength have been obtained. Thus, equipment of tantalum is now electroplated, either externally or internally, with the desired thickness of cheaper metal; and an installation of practically perfect resistance to any concentration of almost any acid mixture can be made. The expense of this rare metal and the labor involved in its purification and fabrication are justified where nothing else will serve.

Aluminum—Pure acid, containing less than about 4 per cent water, has practically no effect on aluminum, but larger quantities of water increase the rate of attack. Nevertheless, in many cases dilution does not prevent the satisfactory use of this metal. Formic acid, present in any strength acetic as an impurity in quantities down to a fraction of a per cent, causes a rapid destruction of aluminum. Where this impurity is not present, aluminum is preferred to copper for glacial acid because the trace of copper which is dissolved in the presence of air discolors the acid, while a trace of aluminum does not. Aluminum condenser tubes for glacial acid (not containing formic acid) are good practice if the cooling water is not alkaline.

In the range of anhydrous or glacial acid, other materials of construction are much in evidence. Silver tubing and condensers have long been standard practice for this strong acid, and instances are known where such equipment has been in service for over 20 years. Storage vessels, pipes and cocks of chemical stoneware also are in use for handling this grade of acid, as also are pipe lines of Pyrex glass tubing joined with rubber sleeves or special glass flanges. Pyrex glass piping, employing an improved connection between lengths which has recently been perfected, and Pyrex glass equipment in large industrial sizes, are being used in handling glacial as well as weaker acids. The corrosion-resisting advantages of Pyrex are self-evident and breakage has been found negligible when the tubing is correctly installed.

As acetic acid is produced and used in the newer processes, and new corrosion problems are experienced, new metals, alloys and methods of fabrication are being simultaneously developed for the successful handling of the conditions encountered. At the present time, the situations are so varied and the available construction materials so numerous that even for the identical operation in different plants, the materials used will vary widely. It is probable, however, that the next few years will see the adoption of many standards and the selection of a few materials of wider applicability.

Editor's Note—Dr. Othmer wishes to acknowledge his prior use of a part of the material of this article in the March, 1932, issue of *Heating, Piping and Air Conditioning*, where, under the title of "Problems of Piping Chemicals Typified by Acetic Acid," he discussed phases of acetic acid construction as applied to piping.

Further acknowledgment is due to the Vulcan Copper & Supply Co., of Cincinnati, Ohio, through whose courtesy we reproduce the photographs appearing here.

Bleaching Powder Made By a New Process

By ACHILLE CARUGHI and CARLO PAOLONI

Società Elettrica ed Elettrochimica del Caffaro, Brescia, Italy

A NEW method for the production of bleaching powder has been developed and put into commercial operation in the Brescia works of the Società Elettrica ed Elettrochimica del Caffaro. In the hydrated form the product contains 38-39 per cent of available chlorine and has a water content of about 6 per cent.

The process for the production of the bleaching powder, Siclor, represents a departure from methods heretofore in use. The reaction between hydrated lime and chlorine takes place through the medium of an organic liquid such as carbon tetrachloride, which is capable of dissolving chlorine, but is inert toward lime and chloride of lime. Thus the finely divided lime particles have their entire surfaces exposed to the action of chlorine, which rapidly acts upon them.

As the inert liquid readily absorbs the heat of reaction, it uniformly distributes this heat over the lime particles or over the bleaching powder particles in progress of building; therefore, during the reaction they are constantly kept at the same temperature as the liquid. The carbon tetrachloride accordingly acts as a temperature regulator, and also serves as a means of crystallization of the bleaching powder—at the end of the reaction when the temperature of the mass is dropped below 20 deg. C.

The tetrachloride is separated from the bleaching powder by distillation in vacuum at a low temperature. During the distillation, the latter is partially dehydrated and thus made more stable.

The anhydrous form is obtained by either of two methods. One consists in complete dehydration under high vacuum at the end of the vacuum distillation of the tetrachloride. This dehydration of the material is accomplished without loss of chlorine and without decomposition. The other method of drying takes the form of dehydration in the same carbon tetrachloride in which the hydrated product has been produced. If at the end of the reaction the carbon tetrachloride is boiled, it carries off part of the water from the product. The quantity thus removed is dependent upon the duration of the distillation. If the tetrachloride vapors are condensed and the condensation, after being freed from water, is continuously returned to the boiling mixture, the product can be entirely freed of water of crystallization.

Though the process seemed to be simple, before it could be put into operation two fundamental problems had to be solved: (1) Almost all of the carbon tetrachloride used in the cycle had to be recovered by an economical method; (2) the process had to be made commercial by using equipment complying with all the requirements of practicability, strength, and tightness. The problem of recovering the tetrachloride has been solved by means of distillation under a vacuum at low temperature and condensation of the vapors at low temperature. The recovery is about 99.5 per cent. The second problem has been solved by the use of cylindrical equipment fitted with a stirring device and jacket.

The plant includes: (1) four cylindrical containers provided with stirring devices and jackets for hot and cold water circulation; (2) two horizontal and two vertical condensers capable of condensing quickly and completely the whole of the distilled tetrachloride; (3) a small refrigerating plant for cooling by means of brine; (4) two vacuum pumps for distillation of the tetrachloride and dehydration under high vacuum; and (5) miscellaneous equipment.

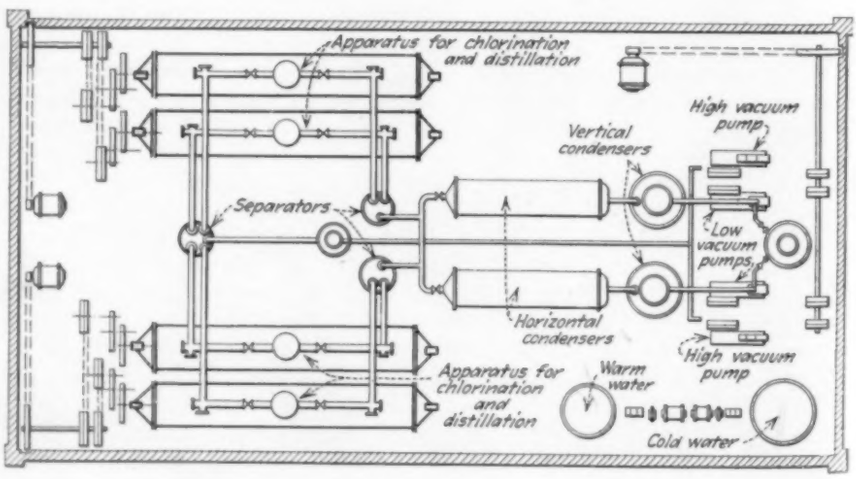
The individual equipment works intermittently, but continuity of working of the aggregate is secured by the four which operate with a suitable time lag with respect to one another. After the lime is loaded into the reaction chamber, the carbon tetrachloride is introduced; and while the stirring device is revolving, the chlorine gas is introduced. The temperature is adjusted from the outside by circulating cold water through the jacket so as to maintain the internal temperature at 35-40 deg. C. The heat exchange between the inside and outside of the apparatus is satisfactory, owing to the presence of the tetrachloride, which acts as an intermediary.

On completion of the chlorination, the temperature is lowered to about 20 deg. C. in order to crystallize the product. After this, the tetrachloride is distilled under vacuum at about 25-30 deg. C. by circulating hot water through the jacket of the equipment and brine through the condensers.

The carbon tetrachloride, owing to the large evaporation surface represented by the bleaching powder particles, evaporates rapidly and is recovered in its entirety in the condensers, after which it is ready to be returned to the cycle.

The Siclor thus dried is conveyed by means of screw conveyors into a bin or directly into casks.

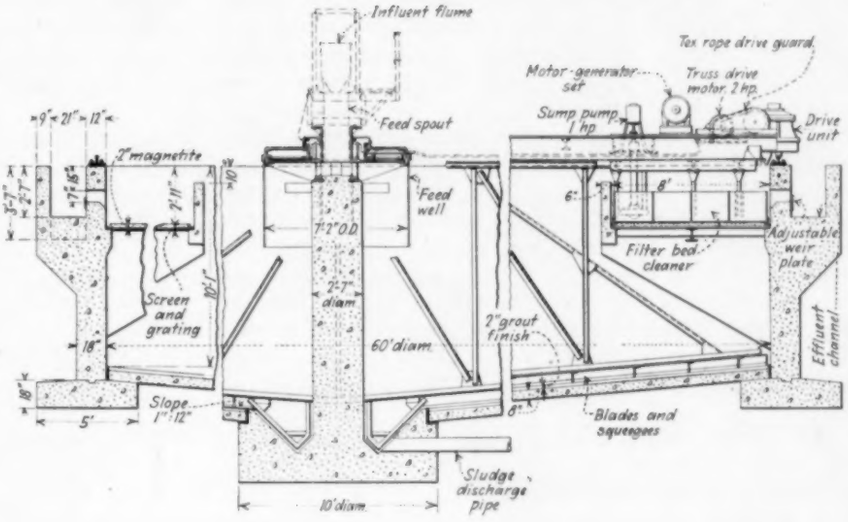
The loss of tetrachloride is about 2.5 kg. for each 100 kg. of the product. The consumption of electric energy for driving power and cooling purposes is 20-25 kw. per 100 kg. of product; the consumption for heating purposes is about 10 kg. of coal per 100 kg. of product.



Plant for the Production of a Bleaching Powder Containing 38-39 Per Cent Available Chlorine

Chemical Methods Adopted For Treating Sewage

Precipitation Takes Place in a Circular Tank Equipped With Revolving Sludge Scrapers. Partly Clarified Sewage Passes Upward Through Crushed and Sized Magnetite



Editor's Note: Developments at the new sewage-treatment plant at Dearborn, Mich., have been watched with considerable interest by chemical engineers because they may hasten a radical change in existing practice in this important field. This article, based on one appearing in *Engineering News-Record* of Feb. 18, 1932, faithfully describes the methods and equipment which will be used.

SEWAGE TREATMENT by chemical precipitation is about to be used in the plant just completed at Dearborn, Mich. A new clarifying element is to be introduced—pulped waste paper as a ready-made floc. The pulp is to be introduced along with lime and ferric chloride; its fibers, serving as nuclei for floc formation, are also expected to facilitate greatly the subsequent vacuum filtration of the undigested sludge. A further departure from the more frequently employed treatment methods is the use of very rapid upward filtration of the precipitation-tank effluent through a thin layer of magnetite that is to be periodically cleaned by a traveling magnetic device. The method of disposing of the dewatered sludge has not yet been determined.

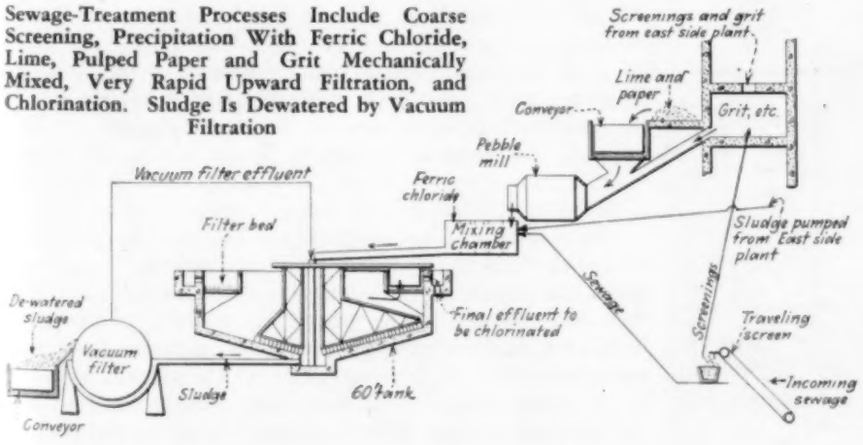
The visitor at the plant is impressed with the marked dissimilarity between it and the more usual sewage works. There are no units out in the open. Pumps, screens, tanks, sewage and sludge filters, chlorine equipment, and the machinery peculiar to the Dearborn plant are all housed in one building. Within the building the impression is one of a chemical plant, with machinery, conveyors, ventilating ducts and overhead cranes very much in evidence. Mark B. Owen, the city's Commissioner of Public Works and Engineering, says that the completed plant will be practically identical in type with one using the cyanide process of gold extraction.

Present sewage flow from the tributary area is 2,750,000 gal. daily, but the units of the new plant are designed to have a capacity of 8 m.g.d. An Imhoff-tank plant on the east side of the city now treats 15 m.g.d., but it is to be modified so as to give plain sedimentation to 30 m.g.d. All the sludge from the old plant is to be pumped through 3 miles of 8-in. pipe to the new plant, where it will be added to the influent of one of the settling tanks.

As thus far planned, no biological process is to be used in the treatment of Dearborn sewage. Solids are to be separated from the sewage by chemical and mechanical means only, producing a clear effluent to be discharged into the River Rouge and a highly concentrated cake of sewage sludge.

Practically all the reagents will be waste-utilization products. Waste lime is to be obtained at a low price from a near-by acetylene plant. Ferric chloride is to be manufactured at the sewage plant by applying chlorine to tin cans and scrap metal collected with the city's refuse. Paper

Sewage-Treatment Processes Include Coarse Screening, Precipitation With Ferric Chloride, Lime, Pulped Paper and Grit Mechanically Mixed, Very Rapid Upward Filtration, and Chlorination. Sludge Is Dewatered by Vacuum Filtration



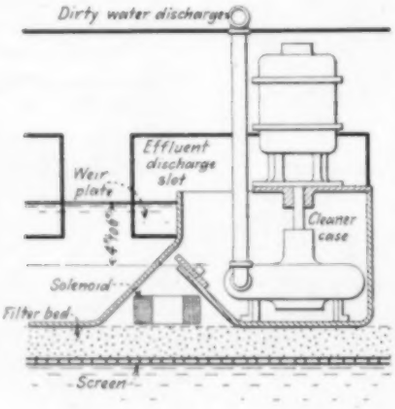
pulp is to be prepared in a pebble mill from waste paper collected by the city. Chlorine, both for making ferric chloride and for disinfection of the final effluent, will be purchased.

Clarification of the screened sewage will take place in two circular precipitation tanks 60 ft. in diameter and from 8½ to 11 ft. deep. The sewage will enter each tank at the center, pass under a circular baffle 7 ft. 2 in. in diameter, and then flow radially outward to and upward through the magnetite filter Mechanically operated scrapers are provided for sludge removal.

In plan, the filter bed is an annular ring occupying the outer 8 ft. of the top of the 60-ft. tank. The filter material is a 2-in. layer of crushed magnetite, supported by a phosphor bronze screen resting on concrete brackets built into the basin wall. A concrete curb resting on the outer ends of the brackets serves to keep the water in the basin from flowing over the top of the filter. When operating, there will be a 16-in. depth of sewage over the magnetite. The unusual filter material was selected primarily because of its weight, which will allow higher rates of upward filtration than would a lighter material such as sand. It is sized so as to pass a No. 10 sieve and be retained on a No. 16. The effluent passes from the top of the filters over a number of weirs set in rectangular openings in the outer wall into a circular effluent channel. The rate of filtration is about 190 m.g. an acre.

The most unusual piece of equipment in the plant is the magnetic device for cleaning the filter. It is contained in a sector-shaped bronze cleaner case, 7 ft. 8 in. long and 4 ft. 6 in. wide at the outer edge of the basin, which is suspended just above the filter surface from the framing supporting the sludge scrapers. The top of the case is a few inches above the surface of the liquid. In the bottom there is a longitudinal opening over which is mounted a long bronze-inclosed solenoid wound about a vertical axis. The solenoid is as long as the cleaner case and about 18 in. wide, and it covers a narrow sector of the filter bed. As the cleaner case slowly traverses the filter, carried around on the sludge-scraper framing, the solenoid is periodically energized by direct current. At those times the magnetic force lifts the filter material violently from its supporting screen into the space inclosed by the solenoid windings, thereby subjecting it to a rather severe stirring and washing by the sudden upsurge of raw liquid from below. The dirty water drains off into the body of the cleaner case, from which it is pumped back into the basin influent.

The sludge drawn from the bottom of the clarification tank is piped to vacuum filters, where it is reduced to a relatively low moisture content. The dewatered sludge will have a high pulp content and will be entirely inoffensive, says Mr. Owen. Its ultimate disposal is still undecided.



Magnetite Filter Bed Is Cleaned by a Traveling Magnet, Which Lifts It From Its Supporting Screen

Dissatisfaction on the part of Henry Ford, the man who pays the largest share of Dearborn's taxes, with the efficiency of the biological methods most frequently used in sewage treatment was the occasion for the development of the plant processes as described. Specifically, that dissatisfaction was given voice in his refusal to sell to the city the site for a proposed plant until the treatment processes to be employed met with his approval. Upon his examination of the plans for the present sewage-works, he expressed satisfaction and forthwith donated the site to the city. In the meanwhile, experimental work had been carried on for a year to develop a satisfactory process.

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Sources of Information On Plant Location

By HORTON R. PARKER
Nutley, N. J.

THE average manufacturer planning a removal to another section of the country generally has only a vague idea of where he would like to locate his new factory. His first letters and advertisements bring a large number of beautiful folios submitted to him by zealous representatives of cities in all sections of the country. On reading these he finds that labor conditions apparently are ideal in all sections of the country; the climate is always healthful; transportation facilities are excellent; and power is unlimited.

Does he realize that there are several sources of reliable unbiased information concerning the factors that are really worth his consideration? Most of the principal sources of information will be found outlined in the books and pamphlets listed in this article.

The U. S. Department of Commerce[1] has published a pamphlet tabulating 25 factors that should be considered in estimating the advantage of a community. Detailed subheadings are given which amplify each item. An especially valuable feature of this report is the separate listing of these 25 factors with a list of the primary sources of information for each item. This section contains references to both governmental and non-governmental publications. Under the heading of Location are listed the following regional surveys: Commercial Survey of the Southeast; Industrial Structure of New England; Commercial Survey of the Pacific Southwest; all containing reliable information compiled by specialists in such work. In these commercial surveys of the various economic areas of the country, manufacturing is discussed in relation to the factors inducing the industries to move into the region.

The Industrial Club of St. Louis has published a similar booklet[2] listing 30 items which are intended to reveal the development of the location under consideration. In this list will be found numerous factors which are important and which might easily be overlooked by the manufacturer. A bibliography of 13 pages contains references to magazine articles, books, and governmental publications dealing with the selection of locations for

industries. A list is given of the industrial surveys of some of the larger communities which are available for distribution.

At the request of the National Electric Light Association the Metropolitan Life Insurance Co. has prepared a factual survey[3] showing the extent and character of the industrial development throughout the Unites States and Canada. According to the summary of this survey, 2,084 communities contributed their experience with the migration of industry and other forms of industrial development. These represented 75 per cent of the total urban population of the United States and about two-thirds of the urban population of Canada. The collective experience of these communities reflects the history of about sixteen thousand firms. A list of sixteen reasons for location resulted and the 126-page report gives a detailed analysis of the answers received.

The Metropolitan Life Insurance Co. is in a position to offer an economic service to business due to the wide insurance coverage which it has in the United States and Canada. Economic investigations have been made of entire industries and also of geographical districts. These various reports have been listed[4] and are well worth investigation. The manufacturer may find that some phase of his own problem has been investigated in sufficient detail to allow him to make an intelligent decision as to his future progress. The index is free, as are also many of the publications.

A study[5] was undertaken by the State University of Iowa to discover the cause and nature of industrial migration in the United States. Analyses were made of statistics of manufactures in the United States and tables are given from the various census reports showing the tendency in industrial migration for specific industries. The manufacturer will find detailed figures and some comments on the figures for 55 of the leading industries.

The U. S. Department of Commerce issues an annual guide[6] which presents a statement of the market research activities of public and private agencies. The references are obtained by sending a questionnaire to all agencies known to be conducting research bearing on marketing. A detailed listing and discussion is given of the publications of the chambers of commerce, engineering and research organizations, state departments and state universities, etc. The Industrial Club of St. Louis[7] has published an exhaustive statement of information available in the last census of distribution. An ample list of the leading governmental and private references to data on marketing, market surveys, distribution, wealth, population, and affiliated subjects is given.

Considerable information concerning the possibilities of any section can be obtained by a study of the industries in that section. The labor departments of the states of Pennsylvania, North Carolina, Arkansas, and some others have published industrial directories listing their industries with financial statistics concerning their growth. In some cases these directories have been compiled by private organizations.

For the manufacturer in the New York City district the eight large volumes of the plan for the New York Region[8] contain engineering and economic information which has cost something in the order of $1,000,000 to assemble. An area of 5,528 square miles with a population of 10,000,000 people was studied. Monographs on the chemical, wood, tobacco, printing, food, clothing, and textile industries were published. An outline[8] of this plan has been published in one volume which gives an entertaining and readable discussion of the entire series. Similar regional plans have been prepared or are in preparation by a number of the larger industrial centers. These are available in the larger libraries.

A series of books that do not bear directly on the problem of plant location, but which have proved of great value when detailed descriptions of port facilities and waterfront conditions are required is the Port Series published by the War Department at Washington. The volumes are written primarily for vessels desiring to call at the port, but the tabulation of industries and physical conditions along the waterfront is valuable to any industry seeking a waterfront location.

For the manufacturer who is specifically interested in a Southern location the Blue Book of Southern Progress[10] annually gathers and assembles statistics applied to the South.

Several excellent books are available which are of more than general interest in the matter of plant location. Most of these are of value to the student as well as of practical use to the manufacturer interested in the future possibilities in his industry. They are listed in the selected bibliography that follows.

Selected Bibliography of Plant Location

[1]Suggestions for Outline of a City Survey. By A. L. Bush. U. S. Department of Commerce. Domestic Commerce Series No. 45, 1931.

[2]Industrial Surveys, an Outline for Communities and Manufacturers. By George C. Smith. Published by the Industrial Club of St. Louis, Mo., 1930.

[3]Industrial Development in the United States and Canada, 1926-1927. The Metropolitan Life Insurance Co., New York City.

[4]Index of Economic Reports, 1930. Metropolitan Life Insurance Co., New York City.

[5]Industrial Migration in the United States, 1924-1927. By H. H. McCarty, College of Commerce, State University of Iowa, 1930.

[6]Market Research Agencies, 1930. U. S. Department of Commerce. Domestic Commerce Series No. 6. A guide to the publications and activities relating to domestic marketing.

[7]An Outline for Market Surveys. Prepared for manufacturers, distributors and communities. By George C. Smith. Published by the Industrial Club of St. Louis, Mo., 1930.

[8]Regional Plan of New York and Its Environs. New York City, 1928-1929.

[9]Mastering a Metropolis. By R. L. Duffus, Harper & Brothers.

[10]The Blue Book of Southern Progress. Manufacturers' Record, Baltimore.

Recent Books

Recent Economic Changes in the United States. McGraw-Hill Book Co. 2 Vols., 950 pages; 1929.
Study of our economic system which has resulted from the President's Conference of Unemployment of 1921. The survey of Recent Economic Changes is an analysis of conditions since the depression of 1920-1921.

Theory of the Location of Industry. Alfred Weber. University of Chicago Press. 256 pages; 1929. A translation of the German edition. A theoretical discussion of chief value to the student.

Plant Location. McGraw-Hill Book Co. A survey of the usual factors influencing growth of the chemical industries of the United States. Appeared in the editorial pages of *Chem. & Met.* in 1927.

Plant Location. W. Gerald Holmes. McGraw-Hill Book Co., 1930. A detailed discussion of the factors influencing plant location and based largely on the information contained in the survey of the Metropolitan Life Insurance Co.

Industries of America. Manufacturing. Malcolm Kier. The Ronald Press, 1928.

Representative Industries in the United States. Edited by H. T. Warshow. Henry Holt, New York City, 1928. 702 pages. An exposition of the growth of representative industries, each industry being discussed by a man who has been closely associated with the growth and development of the industry.

The Coming of Industry to the South. Edited by W. J. Carson. P. S. King & Son. 296 pages. Twenty-seven articles on the basic industries as well as some of the factors which usually are considered in seeking a location.

Ports and Terminal Facilities. Roy S. MacElwee. McGraw-Hill Book Co. A discussion of the factors which make a successful port and a description of the leading ports of the world.

Industrial Evolution. By N. S. B. Gras. Harvard University Press, Cambridge, Mass. A non-technical history of manufacturing. Primarily a record of the progress made in some of the basic manufacturing industries. Industrial advancement in Europe and America is included.

American Industry and Commerce. By E. D. Durand. Ginn & Co. A general discussion of the growth of American Industry. The basic industries are considered, as well as the general economic factors influencing industrial growth.

A Metal Base to One or Both Sides of Which a Suitable Felted Material Has Been Attached by a Metallic Adhesive. First Specimen on Left Is Terne Plate and Alpha Cellulose, Others Are Asbestos-Felted Terne Plate

Corrosion-Resistant Material Made With Metallic Adhesive

By A. W. COFFMAN

Mellon Institute of Industrial Research
Pittsburgh, Pa.

A SYSTEMATIC survey of the field of metallic and non-metallic protected coatings with particular reference to constructional materials, together with a broad program of original research relating to several outstanding problems in the field of protection against corrosion, has been the interest of a series of fellowships sustained by the H. H. Robertson Co. at Mellon Institute of Industrial Research. A result of these investigations has been the semi-plant scale development of a metal base to one or both sides of which a suitable felted material has been attached by a metal adhesive. The felt of the resultant laminated material may then be saturated with any suitable saturant, such as an asphalt, oil, or resin, to produce a waterproof and corrosive-resistant felt. Additional protection and attractive appearance are effected by the superposition of color on the outer surface of the felt. The process need not be confined to the coating of flat shapes.

Soldering, welding, and brazing are familiar examples of the use of certain metals as adhesives for other metals. Most metal-joining operations, in fact, are carried out by attaching together metal sections by some third metal or alloy, which usually performs a similar rôle to that which glue takes in the ordinary gluing process. There is, of course, a difference between the two processes, in that the metallic adhesive must actually alloy to form a strong joint.

It is well known that hot metals are first plastic at the lower temperatures, and that then, as an increase in temperature occurs, they pass from the plastic to the liquid state. I have combined this fact with the conception of gluing in evolving a method for affixing fibrous materials to metals.

If fibrous materials are pressed onto metals which are coated with a suitable metal, some slight adhesion of fiber to metal is observed in certain spots over the surface of the metal, even at room temperature. Raising the temperature of the metal progressively improves such adhesion; and finally, when conditions of temperature, pressure, and final cooling are properly adjusted, an adhesion of fibrous materials is obtained that is sufficiently satisfactory to enable the working and forming of the composite material. It has been observed that the adhesion takes place both below and above the melting point of the metal adhesive, although the optimum adhesional conditions are to be found near and above the melting point of the adhesive.

The temperature limits of adhesion for tin plate, lead-clad iron, galvanized iron, and terne plate were determined in a small experimental rolling mill having rolls 4 in. in diameter. Small sheets of metal-coated steel were heated in a furnace at given temperatures and then passed into the rolls after applying therein a preheated felt. During the course of this work it was observed that two types of adhesion were to be found. The first occurred at lower temperatures and was somewhat superficial. In this case it was possible to remove the felt partially by severely bending the specimen. The second form of adhesion appeared nearer and above the melting point of the adhesive; in this case it was impossible to

remove the felt by bending, and even scratching the felt with a knife failed to remove all the fibers from the surface of the metal. From now on these two types of adhesion will be referred to as apparent and actual adhesion, respectively.

Temperature Limits for Adhesion

Adhesive Metal	Apparent Adhesion Temperature Limits, Deg. C.	Actual Adhesion Temperature Limits, Deg. C.
Zinc	270 to 440	440 to 490
Lead	140 to 310	310 to 450
Tin	150 to 230	230 to 380
Terne	150 to 210	210 to 450

The upper temperature limits of actual adhesion are determined not entirely by lack of adhesion of felt but also by the fact that at these temperatures the metal coating becomes brittle in some cases. Then, too, in the case of asbestos felt, blisters occur in the felt, resulting in a poor coating. It should be pointed out that the quantity of metal adhesive employed also has a decided influence on the temperature of optimum adhesion.

Pressures used in applying fibrous felts to the metal vary with the nature of the felt, the kind and quality of adhesive used, and the temperature of application, while the adhesive used is selected according to the nature of the fibrous material applied. Obviously, adhesives that are effective in the low-temperature ranges should be chosen for employment with readily charring materials. It has also been found that preheating treatments before application, to remove moisture from the felt, facilitates the ease with which best adhesion is obtained.

This brief description of the method for bonding fibrous materials to metals has been given to facilitate a plain visualization of the final product. This product, a new protected metal called Robertson-Bonded-Metal, consists of a metal base to one or both sides of which a suitable felted material has been attached by a metal adhesive. The new bonded metal is adapted to considerable distortion by mechanical working. It must be borne in mind, however, that the limiting distortional factor is the nature of the felted material, the adhesive bond being plastic. A tightly woven felt can be bent and deformed much less readily before rupture than a loosely felted material. Samples are shown in an accompanying figure that have been bent to various sharp angles. The four samples on the right indicate the effects produced on an asbestos-felted terne plate. The superiority of a more loosely prepared felt is exhibited by the fifth sample, which is one composed of terne plate and alpha-cellulose. In this case the metal has been bent back upon itself without injuring the felt, whereas increasingly severe bending of the asbestos-coated samples produced an increased amount of felt cracking. Cracks shown in the last three samples may be closed up with filler in the saturating and finishing steps. With adequate care, however, it is possible to form the unsaturated material in many of the usual methods. It may be cut with the tools customarily found in a tin shop; it may be corrugated, rolled into pipe form, bent, and even subjected to mild drawing operations without detriment to the felt. Samples of the metal coated with asbestos felt have been elongated by cold-rolling to the extent of 8 per cent of their original length, while similar alpha-cellulose coated samples have been elongated in the same manner by an amount equal to 11.5 per cent of their original length.

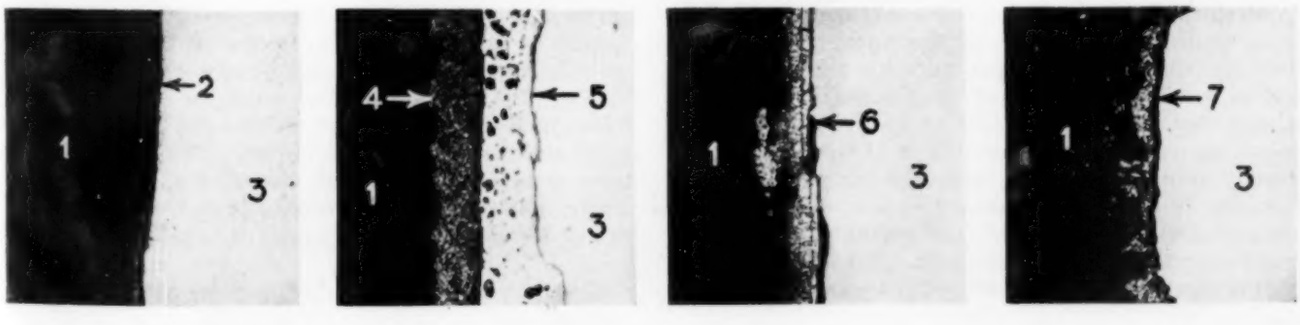
Even after the saturating and finishing operations, the resultant products may be cut with a hand or jig saw and drilled. Ordinary methods of fastening, such as nailing, bolting, and riveting, may be employed. Welding and soldering, however, will produce unprotected joints that are undesirable. If the saturant used is one that is sufficiently plastic, corrugating and mild bending and forming operations may be employed after saturation.

One of the first requisites of a protected metal is that the protection given be adequate for the service conditions involved. The new metal promises flexibility in this respect. The material in any of its finished forms consists of four layers that may all be changed to meet the corrosive conditions involved. These layers are as follows: (1) the core, which may in itself, if desired, be resistant to corrosion; (2) the layer of metal adhesive, which may be varied according to needs and which forms a protective layer over the core; (3) a layer of felt, which may be asbestos and which may be saturated with a variety of materials to meet the conditions of exposure; (4) the final waterproofing and decorative layer, which may take the form of paint, lacquer, wood veneer, pitches, plastic molding composition, or metal foil.

Indications are that certain combinations of these four layers are effective in combating corrosive conditions encountered in the atmosphere, in salt sprays, in alternate immersion tests, and in the hoods of analytical laboratories where nitric, sulphuric, and hydrochloric acids are evaporated.

Additional advantages of this product are as follows: (1) its resistance to heat and fire; (2) its increased insulating value over bare metal; (3) its soundless character—it has none of the "ring" present in sheet metal; and (4) its strength properties, which are essentially those of the metal core. It is quite obvious that the extent to which these properties are effective is again dependent upon the nature and thickness of the protective layers.

Photomicrographs Showing the Bond Obtained Between Asbestos Felt and Steel When Employing Metal as Adhesive. Key to Numbers: 1, Felt; 2, Tin; 3, Steel; 4, Lead; 5, Alloy; 6, Zinc; 7, Terne



Drying and Air-Conditioning In Cable Manufacturing

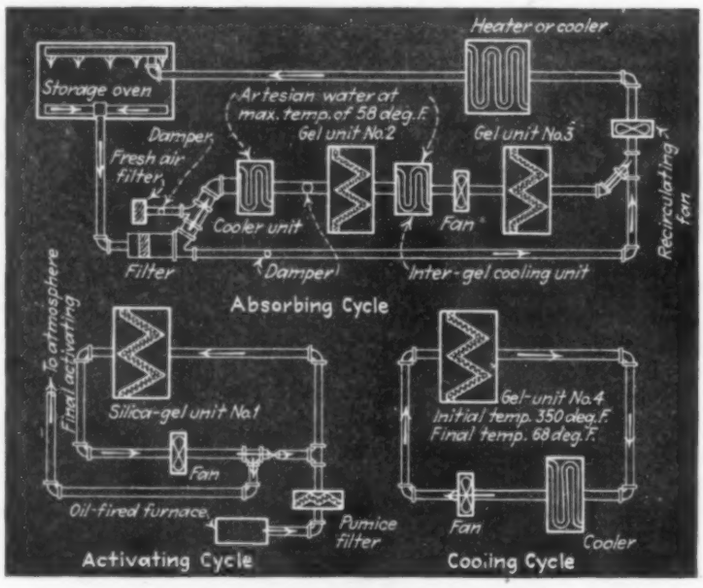
By J. WELLS and L. G. WADE

Western Electric Co., Point Breeze Works
Baltimore, Md.

An economical method has been developed and is now in commercial operation for maintaining a 100x50x10 ft. storage room at 100 deg. F. and the extremely low relative humidity of 0.5 per cent

AN average relative humidity of 0.5 per cent at 100 deg. F. is maintained in a storage oven at the Baltimore plant of the Western Electric Co. This air-conditioning system has been in operation for 18 months. The justification for maintaining a room 277 ft. long, 50 ft. wide, and 12 ft. high at such a low relative humidity was found in a thorough economic study of the cost of manufacture of telephone cable and the value of improved voice transmission to be expected from change in the drying process. A thoroughly dry cable gives improved transmission that has been definitely evaluated per mile for each size of conductor.

Cables are first thoroughly dried in vacuum ovens and then stored in the air-conditioned room until ready for covering; many of them must be kept there overnight. If cables were covered immediately after the completion of the vacuum-drying cycle, a very low moisture content would be obtained. It is not possible, however, to cover cables immediately, as the large number of varying diameters of cables would require an excessive amount of lead-press equipment. The other alternative, to store cable in the dryers until ready for lead covering, requires an excessive investment in drying equipment, which, if used for storage purposes, would result in abnormally low activity as far as actual drying service is concerned.

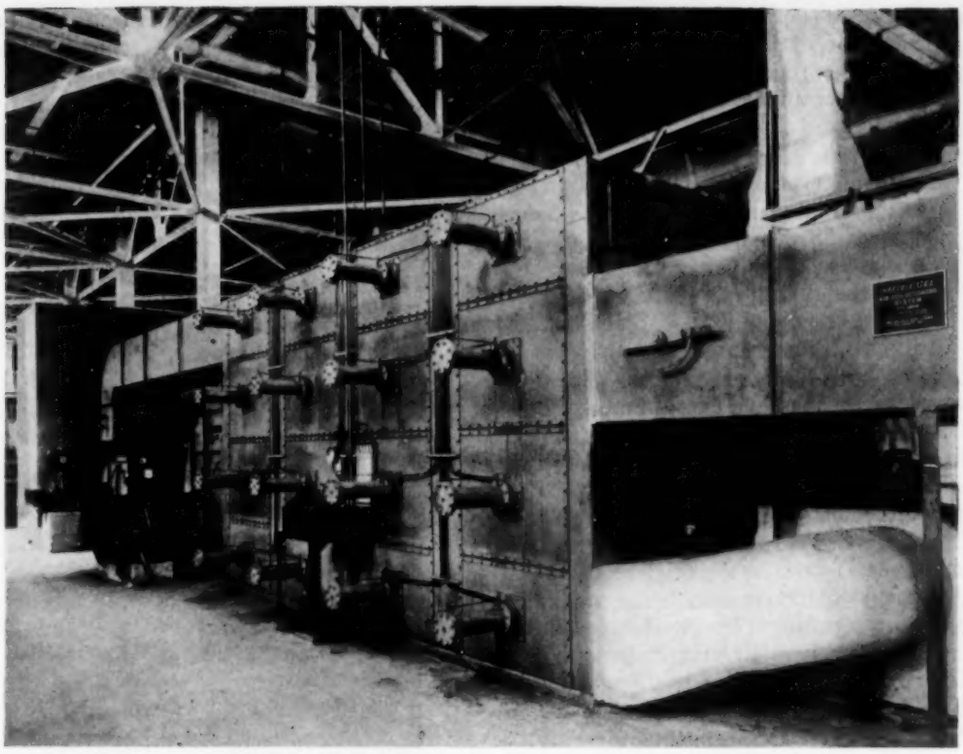


Schematic Diagram of Absorbing, Activating and Cooling Cycles for Creating Atmosphere of 0.5 Relative Humidity at 100 Deg. F.

The design of equipment to meet the storage-room requirements presented a number of interesting problems, particularly in view of the meager information then available on low relative humidity conditions. In a conditioned room, in addition to the problem of maintaining low humidity, cooling is involved to hold the operating temperature from 100 to 115 deg. F., a reasonably comfortable working range when the relative humidity is held at this extremely low value. This is accomplished by 12,000 cu.ft. per minute of recirculated room air and 12,900 of dried air, both of which have been cooled to 75 deg. or less. It is necessary, with the ultimate capacity of the room, to remove approximately 14,000 B.t.u. per minute, although for short periods this figure may reach 17,500.

The largest factor to be taken care of by the cooling medium is the heat given up by the cables which come from the dryers into the storage oven at a temperature of 260 deg. F. The presence of a portion of the vacuum dryers in the oven, opening of dryers to release cables, lights, and the like all add to the heat. The opening of a dryer releases approximately 19,000 B.t.u. per minute for the first few minutes the dryer is open, and the openings under normal operating conditions average 15 or 16 a day.

Heat losses also affect the question of temperature



Silica Gel Absorbers, Damper Cylinders, Adsorber Fan and After-Cooler in a Compact Arrangement

control. Changes in outside temperature result in a variation in the loss of heat through the walls. The establishment of maximum outside temperature conditions required a study of Baltimore climatic conditions over a number of years, the maximum average outside temperature arrived at over a period of 12 hours being 97 deg. F. There are also the heat losses through opening of the doors and the conduction of heat through 13,800 sq.ft. of concrete floor, the maximum temperature of which at the soil line was taken at 65 deg.

The problem of air-conditioning the low relative humidity oven is one of supplying dry air to make up for losses through doors and cable ports and the removal of moisture in the room itself. The moisture in the room is due to infiltration through the walls, ceiling, floor, door openings, and cable ports, men working in the room, and residual moisture in the vacuum dryers at the end of the drying cycle.

Original calculations showed that 2,600 cu.ft. per minute of fresh air would be needed to make up the losses based on a static head of 0.1 in. in the room and that eight complete changes of air per hour would be necessary to maintain under maximum conditions a relative humidity as low as 0.5 per cent at 100 to 115 deg. F. This information was based on experiments conducted with the storage oven at one of the company's other plants. In these experiments the air-conditioning system was closed down and the rate of increase in relative humidity in the oven noted over a period of hours. The quantity of air necessary for eight changes of air per hour in a room 50 ft. wide, 12 ft. high, and 277 ft. long would require an excessive size of equipment. It was decided, therefore, to take particular care to reduce infiltration of moisture and to use only five changes of air per hour.

Walls of the storage oven were constructed as follows: Over the inside surface of an 8-in. brick wall was placed an overlapped layer of sheet-aluminum foil laid on rag felt and hot asphalt pitch. Rag felt and hot asphalt pitch were then laid over the foil and the remaining 4 in. of the 12 in. brick wall laid over the moisture-proof membrane. The same type of membrane was placed in the concrete floor 5 in. below the surface. The concrete ceiling was made moisture-proof by attaching a layer of overlapped foil to the ceiling with a suitable adhesive. The cable ports were covered by an airtight tube leading to the lead-press die block. All passages were equipped with vestibules, and gaskets were installed on all doors.

Two methods of producing dry air were considered for maintaining the storage oven: straight refrigeration and Silica Gel plus refrigeration. The chemical means, such as passing air over sulphuric acid or special chemical salts, were entirely impractical for the large volumes of air required.

The use of straight refrigeration necessitates chilling the air to a temperature of approximately —46 deg. F. Refrigeration for a dew point of —46 deg. would require at least 5.5 hp. per ton, which, together with the steam cost to bring the air up to such a temperature as would keep the storage room at the desired operating condition, makes this type of equipment very expensive. Also there is the difficult problem of preventing any trace of frost particles in the air at this temperature, as any entrainment would seriously compromise the air in the storage oven. The cost of refrigeration equipment to meet these requirements compared to the operating experience in using a small Silica Gel unit and refrigeration at one of the other plants led to the choice of this material.

The property of moisture adsorption is greatly affected by the temperature at which the adsorption process is to take place. The gel in the Point Breeze equipment will

adsorb approximately 20 per cent of its weight in moisture at an efficiency of 98 per cent and a temperature of 77 deg. F. before the breakpoint of the gel is reached. The efficiency of this material at one of the other plants was based on supplying air at 34 deg. Improvements in the manufacture of the gel, however, have made it possible to obtain equivalent efficiencies by supplying air at 68 deg. This fact permitted the substitution of deep well water (temperature 58 deg.) as a cooling medium with a resulting decrease in cost of operation.

As noted previously the quantity of dried air delivered to the room is 12,900 cu.ft. per minute. Of this quantity 2,600 is fresh air and 10,300 is recirculated air from the storage oven. The problem then was to supply Silica Gel adsorbers of a capacity to remove a maximum of 4 lb. of water from 2,600 ft. of fresh air per minute under extreme summer conditions and 0.6 lb. of water from 10,300 cu.ft. of recirculated air. The determination of the maximum moisture condition over a period of years was necessary so that the system would not be compromised.

An interesting feature of the system is the method of distribution of air in the room. This consists in supplying the air at approximately 3 to 4 ft. from the floor through grille openings spaced along the length of the room. This method has the advantage of supplying air at the level at which cables are stored, thus insuring the driest air where it is needed. The return air duct is located near the ceiling on the opposite side of the room. Any regain of moisture in the room itself is, therefore, largely concentrated in air strata above the cables.

The rate of regain of moisture by the paper-insulated cables is dependent not only on the difference in vapor pressure of the air passing over it and vapor pressure in the cable itself but also upon the velocity of the air. This velocity is reduced to the lowest value consistent with positive circulation by the large number of grilles.

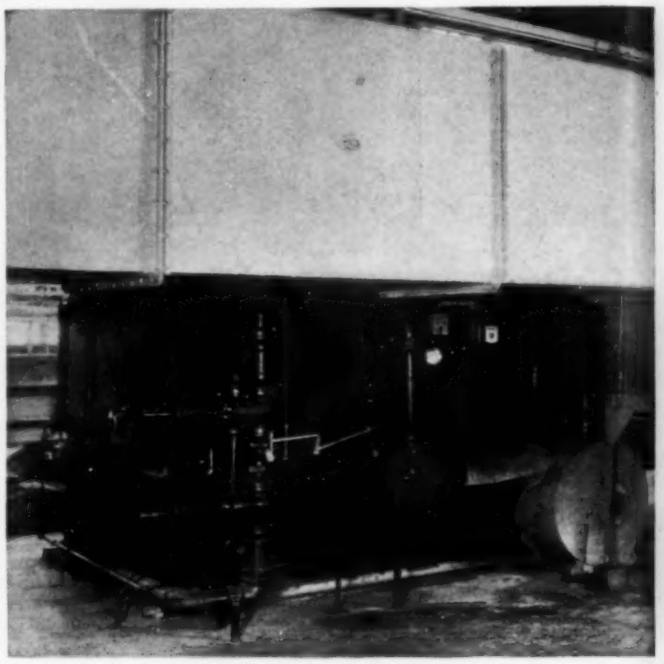
The air-conditioning system consists of the following units: Silica Gel adsorbers, activation furnace, air-circulating fans, air filters, coolers, and control system. In the operation of the system, which is entirely automatic, there are four simultaneous cycles, as follows: first-stage adsorption, second-stage adsorption, activation, and cooling. All recirculated and fresh air is first cleaned by passing through a continuous electrically operated filter to remove all dirt, soot, or smoke. The filtering of 22,300 cu.ft. per minute of room air is essential, as the dryer openings release smoke in the oven.

Since the gel beds pass through four cycles, each bed must have four inlet dampers and four outlet dampers to connect it to ducts so that it can function as noted above. The dampers are actuated by compressed air on pistons whose movement can be controlled automatically through an electric time clock. The clock drives a cam which is designed for a definite interval determined by the length of time the adsorber can function in the first-stage adsorption cycle. The length of cycle is changed as the absolute moisture content of the fresh air changes. This permits the operation of the system on a longer cycle during the winter season, with a consequent reduction in operating cost. At the specified interval a mercury switch is closed by the action of the cam. The switch closes the circuit of a small motor which drives during a fixed interval to actuate four cams controlling the compressed-air valves. Air is thus distributed to each of the specified cylinders to operate the cast-iron dampers.

The automatic shifting from cycle to cycle insures uniform action of all elements in the system, which permits fixed setting of water flows through all cooling units and stabilizing of the general temperature range for the activation furnace, thus contributing to low cost of operation. There is little left for the operator to do except to make an occasional general inspection to see that all elements are operating in the cycle.

In the adsorption cycle, approximately 10,300 cu.ft. per minute of air from the storage oven is mixed with 2,600 of fresh air. The temperature of this air, which may be as high as 115 deg. F., must be lowered to a temperature not greater than 68 deg. before entering the first gel adsorber. This is effected by passing it over seamless fin-construction copper tubes, through which water at 58-60 deg. is circulating. From this point the air enters a duct, in which are located four dampers having access to each of the four adsorbers, each of which contains about 3,000 lb. of the gel. One of the adsorber dampers is opened, and the air to be dehydrated passes into and through the adsorber and out again on the opposite side to a common first adsorber outlet duct. In this first adsorber, 95 to 97 per cent of the moisture is removed from the air. Another water cooler is located between the first adsorber and the second to remove not only the heat taken up by the air during the adsorption process but also that from the adsorption fan and ducts.

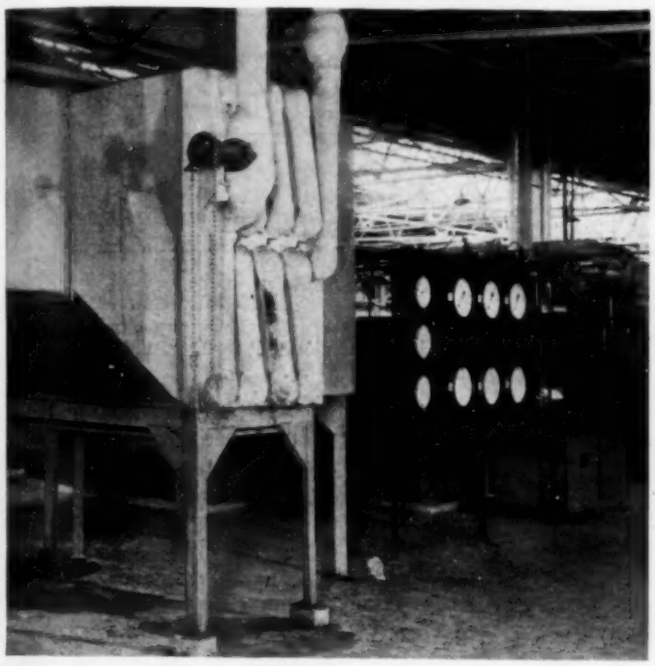
Air now passes through the second and final adsorber and from this point is picked up by the main circulating fan, which distributes it to the supply duct in the storage oven. As stated previously, this air has a moisture content of 0.430 grain per pound of dry air. At the end of the cycle, when the first adsorber has taken up moisture



Activating Furnace, Pre-Cooler and Instrument Panel in the Air Conditioning System of the

to a point approaching saturation of the gel bed, the dampers are changed automatically; the gel bed that was second in the adsorption series becomes the first in the new cycle, and a freshly activated and cooled bed becomes the second bed in series.

The adsorber taken out of the drying cycle is placed in the activation cycle. During the activation process, about 4,500 cu.ft. per minute of air is heated to a temperature of 400 to 450 deg. F. by passing it directly through an oil-fired furnace. It is then passed through a filter bed of pumice stone to remove any uncombined carbon or foreign material, through the Silica Gel bed and the activation fan, and is exhausted to outside air. The amount of heat generated in the furnace is controlled to give a temperature of about 350 deg. in the gel bed itself at the end of the activation cycle.



Cable Core Storage Oven at the Point Breeze Works of the Western Electric Co., Baltimore, Md.

The cooling cycle consists in cooling a freshly activated bed from 350 deg. to a temperature not exceeding 68 deg. The air is recirculated in a closed cycle through a cooler similar to that described above, through the cooling fan, and then through the adsorber. Approximately 90 per cent of the cooling is effected by the waste water from the coolers on the gel inlet air and the cooler between the two adsorbers on the adsorption cycle.

On the instrument board are gages indicating the temperatures prevalent in vital parts of the system, airflow indicating meters, and temperature controls for the activation furnace and storage room. The performance of the entire system can thus be checked at a glance and trouble promptly detected. In addition to this check, alarm signals indicate immediately any failure of oil or water supply.

One of the problems connected with the operation of the system is a means of determining accurately the actual relative humidity of the conditioned room. This is accomplished by use of a specially constructed bridge which records the relative humidity accurately in this range. (Walker and Ernest, *Ind. & Engr. Chem.*, vol. 22, p. 134.)

Successful operation of the room at a humidity of 0.5 per cent is due to three factors: the moisture proofing of the room, continued production of the full-volume of dry air at approximately 0.14 per cent relative humidity at 100 deg. F. from the Silica Gel unit, and raising the operating temperature from 100 deg. to an average of 105 deg. The effectiveness of the moisture-proofing is shown by a test during which the relative humidity in the room rose to 18.4 per cent 50 hours after the conditioning equipment had been shut down, the outside humidity ranging from 65 to 70 per cent. After a period of shutdown, two to three hours of operation of the air-conditioning system is required to condition the room to 0.5 per cent relative humidity. The ease with which the room can be reconditioned has made it practicable to close down the system whenever cables are not stored, such as overnight, holidays, and week ends.

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Air Filtration Methods Discussed

Air filtration was the subject of a paper by Capt. M. E. Barker, at the annual convention of the Compressed Gas Manufacturers' Association in New York City in February, 1932. The efficiencies and advantages of the several types of apparatus that are used for removal of aërosols on an industrial scale were discussed. The types are: (1) settling chambers, (2) cyclone and milliclone dust collectors, (3) washing and spray-cleaning apparatus, (4) ordinary bag filters, (5) specially prepared filtering surfaces similar to blotting paper, (6) electrical precipitation, and (7) apparatus suited to the particular operation, usually a combination of two or more of the above methods.

Settling chambers must have large volumes of very still air, since small particles fall very slowly through air. It has been found that a cyclone collector, operated in connection with phosphate rock grinding, reduced the dust to about 2.1 grains per cubic foot. Of the dust collected in the cyclone, about one-half was retained on a 200-mesh screen, and the remainder passed through the screen. The dust in a special high-efficiency bag filter consisted of 3.5 per cent by weight of the particles held in a 200-mesh screen, while the remainder was called fine dust. The dust collected by the bag filter was at the rate of 2.05 grains per cubic foot. The air treated was small in volume—1,800 cu. ft. per minute.

A Cottrell precipitator installed in a cement factory operating on 100,000 cu.ft. of air per minute, at a temperature of 450 deg. C., gave an over-all recovery efficiency of 95 per cent by weight, or approximately 90 per cent by number of particles. Ordinary spray washers operate at an efficiency of 30-40 per cent. Panel filters of high resistance, similar in structure to the Army gas-mask canister, operate at an efficiency of about 90-95 per cent. However, the efficiency of various pieces of apparatus depends upon the operating conditions.

Performance Characteristics of Cyclone Dust Collectors

By LOUIS C. WHITON, JR.

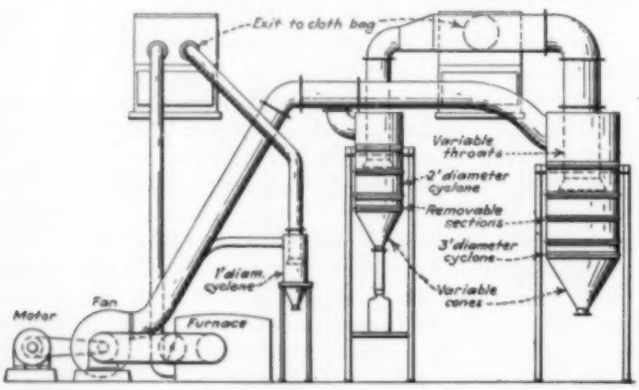
President, Prat-Daniel Corp.
New York City

IN THE PAST there has been comparatively little information published on the operating characteristics of cyclone dust collectors. As a consequence, several years ago the research department of the Prat-Daniel Corp. undertook an extensive investigation which has uncovered a great deal of information, both in regard to the design of cyclone collectors and in respect to their operating characteristics. So voluminous were the results that it is impossible to give here more than a brief résumé of some of the high lights in operating principles that have been formulated as a result of this work.

Part of the work was carried on through the courtesy of the Brooklyn Polytechnic Institute in connection with apparatus which we furnished. Part was performed at our New Rochelle plant and part by the research division of our affiliated French company. Among the conclusions reached are important operating points including: the effect on dust collection of (1) cyclone diameter; (2) gas velocity; (3) gas temperature; (4) dust mesh; and (5) grain loading of the dust. Other data concern the effect of bottom outlet arrangement, rate of emptying of the cyclone and, finally, the distribution of pressure within the collector body.

The apparatus used appears in somewhat simplified form in Fig. 1. It consisted of three experimental cyclones equipped with a number of removable parts which could be assembled in various combinations to produce 108 cyclones of different proportions for each of the three diameters, 1 ft., 2 ft. and 3 ft. A gas-heated brick furnace supplied heated gas for tests at temperatures above atmospheric. Between the furnace and the fan was a hopper for the introduction of the dust. A duct passed to the inlets of the three cyclones which could be blanked off so as to prevent all possibility of the collection of dust in inlets of cyclones not being tested. The outlets of the cyclones were connected by ducts to a canton-flannel filter bag for the recovery of dust not retained by the cyclones. Collection efficiency determinations were made by introducing a known weight of dust and comparing cyclone and filter collection.

Fig. 1—Diagrammatic Layout of Cyclone Test Apparatus



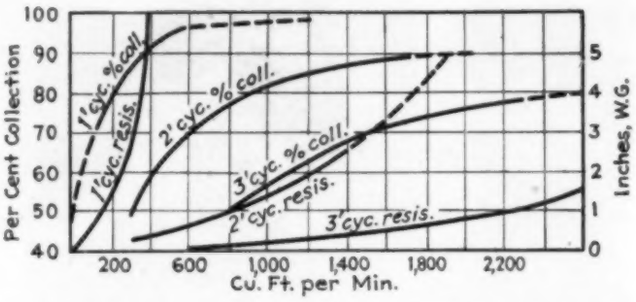


Fig. 2—Collection Efficiency, Resistance and Throughput of 1-Ft., 2-Ft. and 3-Ft. Diameter Cyclones at 80 Deg. F.

Materials tested covered a wide range, including powdered coal fly ash from a large central power station, fullers earth of various meshes, cement kiln dust, gray cement and a variety of industrial products. The tests later to be described were made with the fly ash which was adopted as standard for the tests. As it had been collected by electrostatic precipitators, it possessed an accurate cross-section of particle sizes.

Dust was carefully dried before test and screened for size determinations with a mechanical sieving machine. One series of tests of very practical nature was carried out to determine the economical size of cyclone for various purposes. Theoretically, the smaller the diameter of the cyclone, the greater the collection efficiency. However, since the cost of an installation increases as the cyclone diameter decreases (because of the larger number of smaller cyclones required for equivalent capacity) and since the draft loss—and consequently the operating cost—increases, there is an optimum size for each installation, depending on conditions. It is obvious that a more expensive installation is justified for the recovery of a valuable material than for the abatement of a nuisance.

The matter of construction cost cannot be touched on here, but the effect of throughput and diameter on collection efficiency can be well illustrated with Fig. 2. With each cyclone the collection increases with increase in the throughput. However, the resistance of the cyclone likewise increases. In each curve, it is apparent that beyond a certain optimum point, no important increase in collection occurs. Both collection efficiency and draft loss, it will be noted, drop as the gas volume decreases, resistance falling much more rapidly than collection. To maintain the best conditions in any installation, throughput should be held substantially constant for any single group of cyclones. For this purpose it is easily possible to cut in more or fewer groups, manually or automatically, as the dust supply varies.

Condensed and modified slightly from a paper presented by the author before the Fuels Division, Metropolitan Section, A.S.M.E., Feb. 18, 1932.

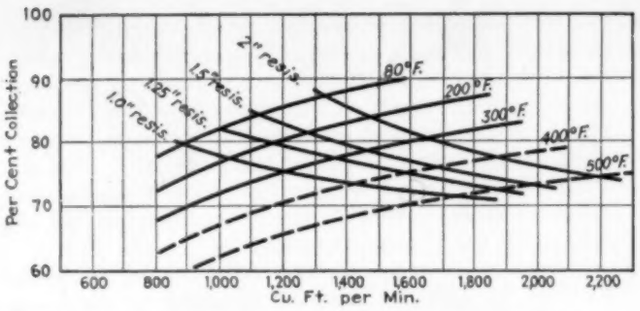


Fig. 3—Collection Efficiency, Resistance and Throughput of 2-Ft. Diameter Cyclone at Temperatures From 80 to 500 Deg. F

It has been pointed out that the allowable draft loss will depend on the circumstances. However, if for practical reasons it be assumed that a loss of 1¼ in. w.g. is optimum, then under the conditions of Fig. 2 the best collection will be obtained with a 2-ft. diameter cyclone. Most of the remaining tests were conducted with this size. The next point of interest was to determine the effect of temperature on collection. Fig. 3 summarizes the results and shows that under the test conditions, collection drops about 2 per cent for each 100-deg. F. temperature rise at constant draft loss. This finding would be expected from Stokes' law which shows the resistance of a fluid to the motion of a particle to depend not only on the particle's radius and speed relative to the fluid but also on the fluid viscosity, which increases with the temperature.

One of the most interesting of the studies was that which demonstrated the effect of particle size and temperature on the collection. It must be emphasized that practically all predictions of over-all collection can be classed only as guesses. Since mechanical collectors are necessarily affected by the fineness of the dust, over-all collection can be predicted only from a knowledge of the collection that will be obtained for each specific mesh of dust. But since the finest screen obtainable commercially is 325 mesh, all minus 325-mesh material necessarily becomes an unknown quantity. There is no entirely satisfactory method of determining the distribution of minus 325-mesh material. If the preponderance of such material is of one fineness, one collection will result; if of another, a different collection will obtain.

In the light of these considerations it is apparent that trial is the only certain method of predicting over-all results. Collection for the fly ash used was explored in the various size groups above 325 mesh by obtaining accurately sized samples, which were then collected at various temperatures and the efficiencies plotted in Fig. 4. The curves, of course, can be used for predicting collection of similar material in a similar cyclone, in the size groups above 325 mesh, provided that a granulometric analysis is available. In order to gain some idea of the results to be expected of finer material, the several curves were extrapolated through what has been labeled the "theoretical area." They were drawn simply by recognizing the fact that collection is necessarily zero at zero size. It will be noted that the sizes corresponding to the theoretical 500- and 1,000-mesh screens have been indicated. (Screen sizes are the U.S. Standard, the theoretical sizes being obtained by extrapolation.)

Since each particle going through a cyclone will be acted on separately, it might be expected that grain loading would exert no effect on collection efficiency. That this is not strictly the case is shown by Fig. 5, where it becomes evident that increased grain loading yields slightly increased collection. It seems likely that the explanation lies in the cushioning effect of the particles on each other, which at higher grain loadings tends to reduce breakage and consequently to improve collection to a small extent.

Interesting observations were made in regard to the effect of various shapes of outlet pipe at the bottom of the cone. It was found that increasing the diameter of the pipe acts rather like a check valve in preventing the dust from being drawn back into the vortex. It was shown conclusively that rapid emptying of the cyclone is much to be desired. If, for example, 6.875 lb. of dust remained in the cone of the 3-ft. cyclone when it was handling 2,450 cu.ft. per minute at a draft loss of 1.2 in. w.g., there was a constant loss of dust of 0.314 per cent per minute.

An effort was made to determine the pressure characteristics inside the cyclone and to explore the location of the vortex. Although the study was chiefly of academic interest, it might be noted that the static pressure at most points varied considerably with the throughput. As the throughput (and draft loss) increased, it was found that there was an increasing positive pressure at points in the inlet and exhaust pipes and just inside the shell at points near the bottom of the throat. Increasingly negative pressures were found at the periphery of the cone and bottom outlet pipe and directly below the throat in the center of the cyclone, while a constant zero pressure was observed at a central point in the cone. It was at this point that the gas invariably turned upward, no matter what the throughput.

Fig. 4—Collection Efficiency Variations With Respect to Particle Size and Temperature in 2-Ft. Diameter Cyclone Handling 1,000 C.F.M.

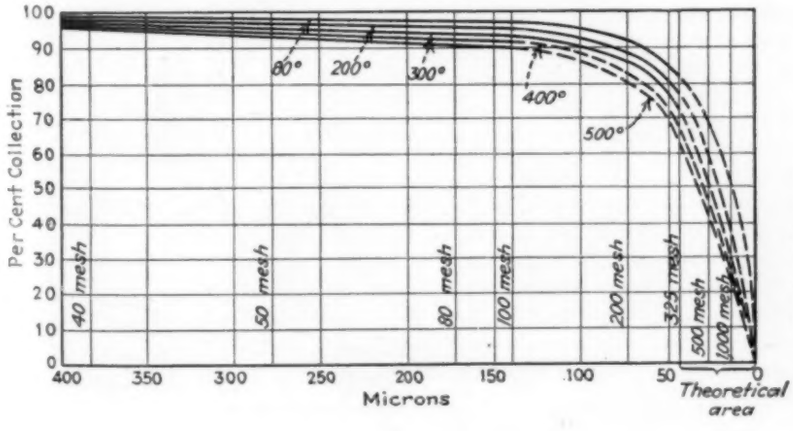
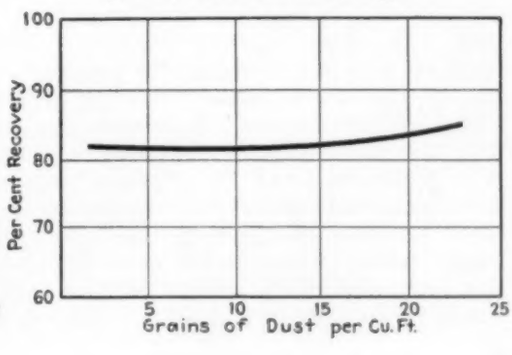


Fig. 5—Effect of Grain Loading in 2-Ft. Diameter Cyclone Handling Fly Ash in 1,000 C.F.M. of Air at 80 Deg. F



Reducing Hazards in Acid Drum Use

By T. P. CALLAHAN

Chairman, Steel Barrels and Drums Committee
Manufacturing Chemists' Association
Washington, D. C.

WORKING in conjunction with the specifications department of the Bureau of Explosives, the steel barrels and drums committee of the Manufacturing Chemists' Association has investigated the handling and stowing of sulphuric and mixed acids in steel drums, and the specifications for permissible drums for this purpose. What follows is a summary of the first of a series of papers on the handling of chemicals in various sorts of containers. It concerns accidents that have occurred in plants using sulphuric acid in drums, pressure tests on drums, and recommended procedure in the handling and filling of drums.

In most of the cases investigated, explosions in acid drums resulted from the accumulation of hydrogen formed by the action of dilute H_2SO_4 on the metal of the drum. As the concentrated acid has a great affinity for water, it is readily diluted by the absorption of atmospheric moisture. There also is the danger of failure on account of the expansion of acid by heat. Still other accidents occurred from miscellaneous causes such as the use of an oxyacetylene torch on a drum which contained hydrogen, and the careless washing of a drum which contained a small quantity of frozen oleum in its upper part. In several of these accidents, the explosions had fatal results.

In order to check the question of strength of drums, a number of tests were made, together with inspections which showed that a fertile cause of accidents has been carelessness in leaving insufficient space for expansion in the filled drum. In his report, the chemist who made the tests stated that he had failed to rupture a number of new and second-hand drums under 60-lb. air pressure. This made it seem unlikely that the drums that were bursting were doing so from faulty construction. Of 52 filled drums which he inspected, 49 contained the specified 3 in. of air space, the remainder having 1¼ to 1½ in. of outage. What effect a rising temperature will have on drums with too little air space is clearly shown in the accompanying curves. Even when there is no gas generated in the drum, a 61-deg. F. rise in a drum with 1¼ in. of space will generate a pressure of 60 lb. per square inch.

The additional effect of gas generation was indicated by other tests in which a drum equipped with a manometer was allowed to stand with 3 in. of air space. Pressure was increased at such a rate that had the drum had 1¼ in. of air space, it would have had to be raised only 51 deg. in temperature to generate a pressure of 60 lb. These tests showed that the drums were sufficiently elastic to throw a dangerous stream on bursting. Use of a large air space intensifies this difficulty.

A consideration of the accidents studied and of the tests conducted pointed to a number of ways in which drum accidents can be eliminated. In the handling of empty drums, repairs should not be made until the drum has been thoroughly washed with soda ash solution. Preferably, the solution should stand in the drum for 12 to 15 hours before emptying. Drums should always be completely drained before filling with water, particularly in the case of oleum, where crystals may adhere to the sides of the drum. In the latter case, a good method is to provide a vertical spray nozzle over which the drum can be placed with the bung hole downward. The water control valve should be at a distance. Washing operations for oleum drums should be conducted in the open, because of the fumes produced.

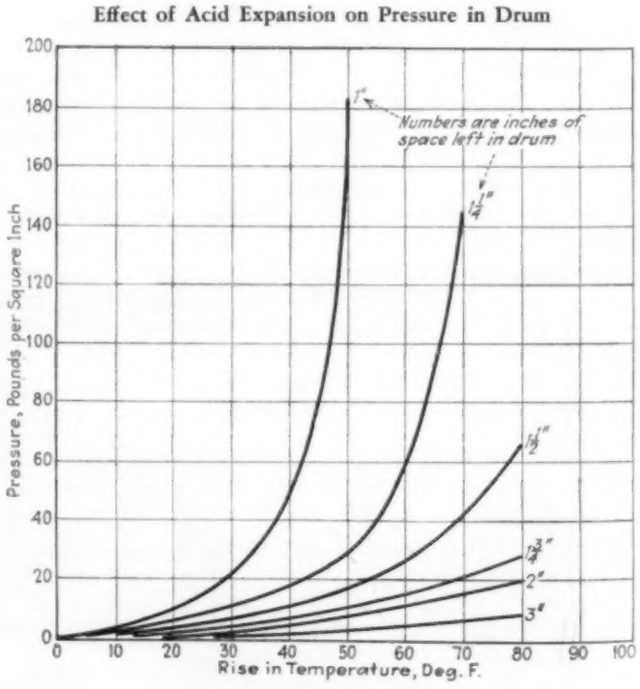
Drums that have been emptied should have the bung screwed in tightly to prevent corrosion of the threads. Loose bungs permit sulphating around the bung hole and internal corrosion, which builds up gas pressure as the sulphate seals the threads.

Obsolete drums should not be wrecked by the use of a pick. An open flame should never be used on an unwashed drum, and after washing, only with the bung removed.

In filling drums, a number of points should be kept in mind. It is poor practice to fill drums in anticipation of orders. They should be filled within 24 hours of shipment. Drums that have lost 15 per cent of the original weight should be rejected. In filling, a minimum of 3½ in. of outage should be allowed. The drums should be marked with the strength of acid contained, and with a caution label warning that the drum should be kept away from sun and heat; that it should be stored with the bung up; and that the pressure should be released every six or seven days.

In storing drums, time of storage should be held to a minimum. The precautions mentioned in the last paragraph should be carefully followed. In opening drums to relieve pressure once a week, the operator should use goggles, rubber gloves, and a long-handled wrench. In discharging drums, pressure should not be used, but rather the drum should be emptied by gravity. Considerable stress can be built up in a drum with a pressure as low as 10 lb., especially in drums that have been thinned in spots. In opening drums it is always good practice first to loosen the bung slightly, permitting the pressure to escape. An open flame should never be used to break the cake of sulphate which may hold the bung.

Effect of Acid Expansion on Pressure in Drum



Pulp and Paper Engineers Discuss Materials of Construction

EDITORIAL STAFF REPORT

DURING the week of Feb. 15, the Technical Association of the Pulp and Paper Industry held its annual convention in New York City. Among the subjects discussed at the symposia were raw materials, waste, heat and power, equipment, and materials of construction.

The group meetings, as usual, were very interesting, and as a result of them a vast quantity of valuable information was made available to the industry. This was particularly true in the case of the materials of construction meeting, where, in addition to the papers that were presented, many mill men exchanged experiences in the use of alloys, carbon, rubber, and treated wood.

In the total manufacturing costs of pulp and paper, the maintenance of equipment is an item of considerable magnitude, Chairman James D. Miller stated in his report of the activities of the committee. During the past two years, several new materials were introduced, the life of which exceeds that of the materials which they have replaced. This effort to reduce the maintenance charge is meeting with success in many cases.

In an effort to examine the present status of materials in service in the industry, comparing where possible more than one material at a service point, and indicating the life of the materials in months and years, the following data were assembled by the committee. As the mills surveyed probably are representative of their class in the industry, and all data relate to materials in actual service, it was hoped that the survey would prove of value in focusing attention on the points where material replacement is most troublesome.

Present Status of Materials in Service

In the following, 18-8 refers to the 18 per cent chromium and 8 per cent nickel alloy, with no information on fabrication methods. Blowpit bottoms, conventionally of wood or tile, have been replaced by 18-8 sheets, $\frac{3}{32}$ in. in thickness with $\frac{1}{16}$-in. slots. When constructed of 3-in. fir planks, the life was about one year; when of tile, the life was good, but replacement was troublesome, due to dislodgment and cracking. The 18-8 plates have been in satisfactory service for three years, with the attendant feature of stock losses.

A case of side and top relief strainers of 18-8 failing by the ball breaking where joined to the neck resulted in return to bronze of 85 per cent Cu, 10 per cent Sn, 5 per cent Zn, which analysis permits a life of one year. Fabricated strainers of 18-8 plate have been in use three years on 100 per cent top-relief, with one failure due to physical change in the metal. Two cast strainers have been in service for two years with thermometer wells of the same 18-8 for three years. The failures recorded probably were due to faulty design or metallurgical causes.

Four-inch 18-8 side-relief valves have been in use for two and one-half years, with bronze valves failing in three to four months. An instance of copper side and top-relief lines being superior to brass is given. Decker lines of 18-8 have been in service for one and a half years, with seven 70-in. sections for three years. For this service brass pipe must be replaced in about nine months. Monel metal stems for blow valves have been found more satisfactory than acid-resisting bronze.

Bleach-plant service is not severe. Common iron pipe for bleach lines is suitable when completely filled, but when not in use for a time will fail in a month to six weeks. Wrought-iron lines are good for one year. Walworth cast-nickel-iron lines have been in service for three years, and cast-iron valves have been in continuous use for 20 years.

Experience With 18-8 Steel

Means for making improvements in the digester department by taking full advantage of the possibilities offered through the use of acid-resistant alloys in the chrome-nickel steel group was suggested by Andreas Christensen, sulphite superintendent of the plant of the Rhinelander Paper Co. The departments closely allied with the digester department—namely, acid making, acid recovery, as well as blow pits—were also covered.

Prior to three years ago, this part of the sulphite mill had not progressed in the same proportion as other departments, because of the lack of a construction material resistant to the highly corrosive effect of hot calcium bisulphite cooking acid. Of the different alloys introduced into the sulphite industry, the one containing about 18 to 20 per cent chromium, 7 to 10 per cent nickel, with small quantities of manganese, silicon, and carbon, has probably found the widest application. Castings are used in sulphite mills today with a wide range of chromium and nickel contents, from the extreme of 30 per cent chromium and 9 per cent nickel to 18 per cent chromium and 7 per cent nickel, with small quantities of the other elements.

As to the relative value of any of these, Christensen has found that where only 17 to 18 per cent chromium is present, greater care must be taken in machining to avoid work hardening. By increasing the chromium content, he is apparently getting away from the borderline metal and has a safer alloy with which to work.

The experience gained during the past two years, he stated, has clearly demonstrated that he is justified in standardizing on this metal wherever hot calcium bisulphite liquor, hot SO_2 gas, and waste liquor were handled. The loss of fiber in the waste liquor from the blowpits has been reduced to a minimum by the use of perforated chrome-nickel drainer bottoms.

Most of the fittings and tubings installed on the

digester relief lines four years ago are still in service and give no indication of being worn out. The failures encountered were mostly on small fittings, subjected to considerable machining, and in every instance the break occurred shortly after the fittings were placed in service.

The savings due to improved operating conditions, increase in yield by the reduction of fiber losses, and better control of the cooking process, directly attributable to the use of chrome-nickel equipment, are difficult to estimate but will by far exceed the equipment cost as a result of the longer life obtained from fittings made with this metal.

The possible improvement of cast iron as it is used in various parts of paper-mill equipment was considered by J. S. Vanick and F. L. LaQue, of the International Nickel Co., by drawing attention to data pertaining directly to the industry as well as to information obtained from tests and experience in similar service.

Usefulness of Alloyed Cast Irons

The usefulness of Ni-Resist, a cast iron containing 14 per cent nickel, 6 per cent copper, and about 2 per cent chromium, for valve, pump and compressor parts exposed to oil vapor with sulphur gases containing moisture has been demonstrated in petroleum refining and considerable quantities are now in use. A recent 275-hour test at the York Haven Paper Co. of this alloy with cast iron in the cooling lines of the acid plant yielded the fact that, in gas containing 14.5 per cent sulphur dioxide at 400 deg. F., this alloyed cast iron lost only one-half as much weight as plain cast iron.

Since some of the tests made with samples of a 6 per cent chromium type of Ni-Resist exposed within digesters indicated that it possessed fair resistance to corrosion as compared with bronze, it is reasonable to expect that its superiority over plain cast iron for handling spent sulphite liquor should justify its use.

The effect of nickel in improving the resistance of iron to corrosion by caustic is shown in the accompanying table covering results of tests in a caustic soda evaporator used in the manufacture of caustic. Obviously iron for such parts as pipe, valves, and pumps, ordinarily made of cast iron, can be mildly improved by small additions of nickel or very much improved from the corrosion standpoint by making it of high nickel alloyed cast iron.

Corrosion of metals by the highly corrosive solutions containing free chlorine, encountered in the bleach plant, is always troublesome. After plant tests the Ni-Resist specimens were sounder, more uniformly corroded, and had suffered less localized attack than the lower alloyed and unalloyed irons. In view of the prejudice against copper alloys in bleach plants, a copper-free Ni-Resist of approximately the following composition might be more desirable: total C, 2.70-3.10; Si, 0.80-1.50; Ni, 18-22; Cr, 2-3.5 per cent. It is conceivable that a less highly alloyed composition would be more economical for use in bleach plants for such equipment as piping, fittings, plug cocks, and pumps.

Gears, sprockets, clutch plates, and similar miscellaneous castings frequently replaced in mill operations require hardness along with machinability and strength. Usually made from ordinary "machinery iron," they can be markedly improved through the use of alloy additions of the order of 1¼ to 1½ per cent nickel with 0.3 to 0.6 chromium.

The physical properties of carbon are such as to make it satisfactory for a constructional material. It has sufficient strength for many purposes combined with resistance to thermal shock, which fits it for use in construction work when rapid thermal changes occur. It is entirely satisfactory as a lining for reaction chambers and towers and for piping, according to A. D. Camp, chemical engineer, National Carbon Co., in his paper dealing with uses of carbon in the pulp and paper industry.

Corrosion of Nickel Cast Iron in 130 Deg. Tw. Caustic at the Boiling Point

No.	T.C	Si	Ni	Cr	Loss in Weight in Mg. per Sq. Dm. per Day
1	3.66	0.97	None	None	366
2	3.03	1.11	3.77	None	235
3	2.88	0.75	6.53	None	247
4	2.73	0.60	16.66	None	152
5	2.67	0.65	19.55	1.80	31
6	2.13	0.51	22.24	None	17
7	2.27	0.61	28.90	None	2

Exhaustive tests under actual service conditions have satisfied a number of paper-mill technicians that carbon linings can be applied with perfect safety to sulphite-and-kraft-pulp digesters, and it is now believed by many that carbon is the ultimate answer to the demand for a long-life or permanent lining.

The success of carbon for linings in digesters probably is due to two main factors: its inertness to chemical attack in the cooking processes, and the fact that carbon does not spall or crack when subjected to sudden thermal changes and physical stresses. It has a low coefficient of thermal expansion and is more elastic than ceramic material.

Because of the lack of chemical attack upon carbon, there are a number of other suggested uses in the pulp and paper industry where highly corrosive conditions are present. Wood sills corrode out within two or three years, but the carbon would last forever under similar conditions. It has also been suggested that the whole blowpit itself be constructed of carbon beams, or a wooden or steel shell be lined with carbon bricks. Vomit stacks are other structures which could be constructed of carbon. Now that impervious carbon in the form of tubes and bricks is available, the construction of sulphite liquor storage tanks, bleach tanks, and stock chests becomes practicable.

Effect of Alkaline Liquors on Alloys

In a paper on the effect of alkaline liquors on some alloys, G. H. McGregor, of the Institute of Paper Chemistry, stated that in a general way it is quite apparent that the chrome and chrome-nickel alloys are much more resistant to the corrosive alkaline liquids than regular cast iron or sheet steel. The non-chromium ferrous metals, including various fabricated cast irons, Monel metal, and copper-molybdenum alloys, are markedly attacked by the various alkaline liquors. Toward the non-ferrous group of alloys, including brasses, bronzes, and high copper alloys the alkaline liquors are very corrosive, which is common knowledge in alkaline pulp manufacture.

Lumber treated with zinc chloride has been used during recent years in increasing quantities for mill and building construction, H. E. Davis, chemical engineer, Grasselli Chemical Co., stated in his contribution on preserved wood for paper mill construction. Many paper mills have replaced decayed roofs of untreated lumber with zinc-chloride lumber. He stated that pressure treatment with the recommended absorption of zinc chloride will increase the service life of untreated timber from three to five times in locations where unusually severe conditions of exposure prevail.

How Properties Affect Handling of Liquefied Petroleum Gases

By T. W. LEGATSKI
Philgas Co.
Detroit, Mich.

BECAUSE liquefied petroleum gases are being manufactured and handled in ever-increasing quantities, a more universal understanding of their properties is desirable. The one most important physical property of liquefied petroleum gas, in so far as shipping and storage problems are concerned, is its coefficient of thermal expansion. Considerable data for the pure components of liquefied petroleum gases are in existence. However, barring recent work of the Bureau of Standards, there apparently exists no complete information on the thermal expansions of commercial products.

The investigation from which the data presented in this article have been taken was conducted in the laboratories of the Phillips Petroleum Co. in cooperation with the Bureau of Explosives. The primary object of the investigation was to obtain sufficient complete and accurate information on the thermal expansions of commercial products for use in the formulation of more rational shipping regulations for such products.

In order to obtain the necessary information, typical commercial products were, in the course of the investigation, synthesized from the pure hydrocarbon components and were then subjected to a series of tests with the object of proving the interrelationship of the results of the several simple tests. The tests made on each product included determinations of the composition, normal boiling points, vapor pressure, specific gravity of the liquid and the coefficient of expansion.

The apparatus used in the determination of the coefficients of expansion over a range of temperatures was of two general types as shown in Fig. 1 *b*, the second being used as a check on the first. Analyses to determine the composition of the samples investigated were made in each case. The method followed was one of low-temperature fractional distillation and the results constituted a direct check on the synthesis of the various mixtures. The nature of the distillation method and apparatus used has been published (*Oil & Gas Journ.*, Oct. 18, 1928). The normal boiling temperatures were determined by means of an open-cylinder weathering test. Hydrocarbon liquid is allowed to boil in an open cylinder, and the temperature obtained by means of a total immersion thermometer for the various percentages evaporated are recorded. These boiling temperatures have been shown to bear a close relationship to the actual percentage composition.

Vapor pressures of all products were determined with the liquefied petroleum gas vapor pressure bomb. The features of this apparatus are such as to eliminate the commonest sources of error in vapor pressure tests and for this reason the results obtained through its use have been found to be very dependable. The liquid specific gravities of the hydrocarbon samples were determined by means of a bomb of similar construction, the method consisting of weighing accurately on a torsion balance a known volume of liquid. This method has been shown to give accurate results (*Oil & Gas Journ.*, Jan. 3, 1929).

Inasmuch as a complete tabulation of the results for all of the individual tests would prove to be rather long, the results for butane alone will be given and the results of the other tests will be presented in a more condensed and usable form. The test results for commercially pure normal butane are presented in Fig. 1 *a*.

In the case of relatively simple mixtures a close interrelationship has been shown to exist between composition and all of the physical properties, and the summarized results of the investigation have been compiled in tabular form to show the relationship between the various average properties (Table I). In addition, a number of useful charts have been prepared to illustrate the effects of the various factors on problems of storage and transportation. In Fig. 2 *a*, is a graphical representation of the expansion data. The allowable loading density for any product and for any temperature condition in the

Fig. 1—(a) Test Results on Normal Butane. (b) Expansion Testing Apparatus. (c) Determined and Permissible Maximum Loading Densities. See Text.

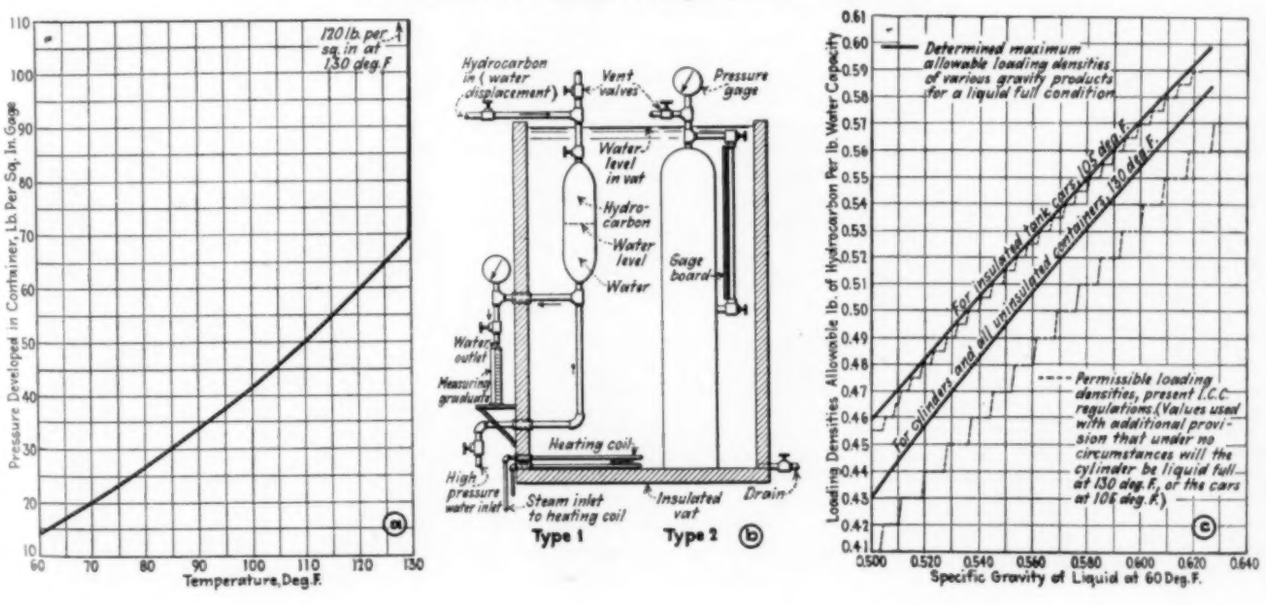

120 lb. per sq. in. at 130 deg. F
Pressure Developed in Container, Lb. Per Sq. In. Gage
Temperature, Deg. F.
Hydrocarbon in (water displacement)
Vent valves
Pressure gage
Water level in vat
Hydrocarbon
Water level
Water
Gage board
Water outlet
Measuring graduate
Heating coil
High pressure water inlet
Steam inlet to heating coil
Insulated vat
Drain
Type 1
Type 2
Determined maximum allowable loading densities of various gravity products for a liquid full condition
for insulated tank cars, 105 deg. F.
for cylinders and all uninsulated containers, 130 deg. F.
Permissible loading densities, present I.C.C. regulations. (Values used with additional provision that under no circumstances will the cylinder be liquid full at 130 deg. F. or the cars at 105 deg. F.)
Loading Densities Allowable lb. of Hydrocarbon Per lb. Water Capacity
Specific Gravity of Liquid at 60 Deg. F.

Table I—Physical Properties and Loading Density Data of Commercial Liquefied Petroleum Gas Products

Approximate Gravity at 60 Deg. F. Specific	A.P.I.	Initial Boiling Point, Deg. F.	Vapor Pressure in Lb./Sq.In. Gage at 70 Deg. F.	105 Deg. F.	130 Deg. F.	Determined Maximum Allowable Loading Density for Max. Temperatures of 105 Deg. F.	130 Deg. F.	Present I.C.C. Loading Density Regulations for Temperatures of 105 Deg. F.	130 Deg. F.
						Per Cent			
0.500	151.5	—51	126	217	302	45.90	43.08	45.5	41.0
0.502	150.5	—49	123	213	296	46.10	43.37	45.5	41.0
0.504	149.5	—48	120	209	291	46.35	43.63	45.5	42.0
0.506	148.0	—46	118	205	285	46.58	43.88	46.0	42.0
0.508	147.0	—45	115	201	279	46.82	44.12	46.0	42.0
0.510	146.0	—43	113	196	273	47.05	44.40	46.5	42.0
0.512	145.0	—42	110	192	268	47.27	44.70	47.0	43.0
0.514	144.0	—40	108	188	262	47.50	44.95	47.0	43.0
0.516	143.0	—38	105	184	256	47.72	45.20	47.5	43.0
0.518	142.0	—37	103	180	251	47.97	45.50	47.5	43.0
0.520	140.5	—35	100	176	245	48.20	45.75	48.0	44.0
0.522	139.5	—34	98	171	240	48.43	46.00	48.0	44.0
0.524	138.5	—32	95	167	234	48.67	46.27	48.5	44.0
0.526	137.5	—31	92	163	228	48.90	46.50	48.5	44.0
0.528	136.5	—29	90	159	223	49.13	46.75	49.0	45.0
0.530	135.5	—28	87	155	217	49.37	47.00	49.0	45.0
0.532	134.5	—26	85	150	212	49.60	47.27	49.5	45.0
0.534	133.5	—24	82	146	206	49.82	47.53	49.5	45.0
0.536	132.5	—22	79	142	201	50.05	47.78	50.0	45.0
0.538	131.5	—21	77	137	195	50.30	48.02	50.0	46.0
0.540	130.5	—19	74	133	189	50.52	48.30	50.0	46.0
0.542	129.5	—17	72	129	183	50.74	48.53	50.5	46.0
0.544	128.5	—15	69	124	178	50.97	48.80	50.5	46.0
0.546	127.5	—13	67	120	172	51.20	49.05	51.0	47.0
0.548	126.5	—12	64	116	167	51.42	49.30	51.0	47.0
0.550	126.0	—10	62	112	161	51.65	49.55	51.5	47.0
0.552	125.0	— 8	59	107	155	51.88	49.80	51.5	47.0
0.554	124.0	— 6	56	103	150	52.10	50.03	52.0	48.0
0.556	123.0	— 4	54	99	144	52.33	50.27	52.0	48.0
0.558	122.0	— 2	51	95	139	52.55	50.52	52.5	48.0
0.560	121.0	0	49	91	133	52.80	50.75	52.5	48.0
0.562	120.5	2	46	87	128	53.02	50.90	53.0	49.0
0.564	119.5	4	44	82	122	53.23	51.24	53.0	49.0
0.566	118.5	7	41	78	116	53.47	51.49	53.0	49.0
0.568	117.5	9	38	74	111	53.70	51.72	53.5	49.0
0.570	116.5	11	36	69	105	53.91	51.95	53.5	50.0
0.572	116.0	13	33	65	100	54.13	52.19	54.0	50.0
0.574	115.0	15	31	61	94	54.35	52.42	54.0	50.0
0.576	114.0	17	28	56	88	54.57	52.65	54.5	50.0
0.578	113.5	19	26	52	83	54.80	52.88	54.5	51.0
0.580	112.5	22	23	48	77	55.00	53.10	54.5	51.0
0.582	111.5	24	20	44	72	55.21	53.34	55.0	51.0
0.584	111.0	26	18	39	67	55.41	53.55	55.0	51.0
0.586	110.0	29	17	37	64	55.62	53.75	55.5	52.0
0.588	109.0	31	15	36	62	55.84	54.00	55.5	52.0
0.590	108.5	33	14	34	60	56.08	54.25	56.0	52.0
0.592	107.5	35	13	32	57	56.30	54.50	56.0	52.0
0.594	107.0	38	12	31	55	56.51	54.75	56.5	53.0
0.596	106.0	40	11	29	53	56.71	55.05	56.5	53.0
0.598	105.0	42	9	27	50	56.93	55.19	56.5	53.0
0.600	104.0	45	8	26	48	57.13	55.38	57.0	53.0

range covered can be readily arrived at by the use of this chart.

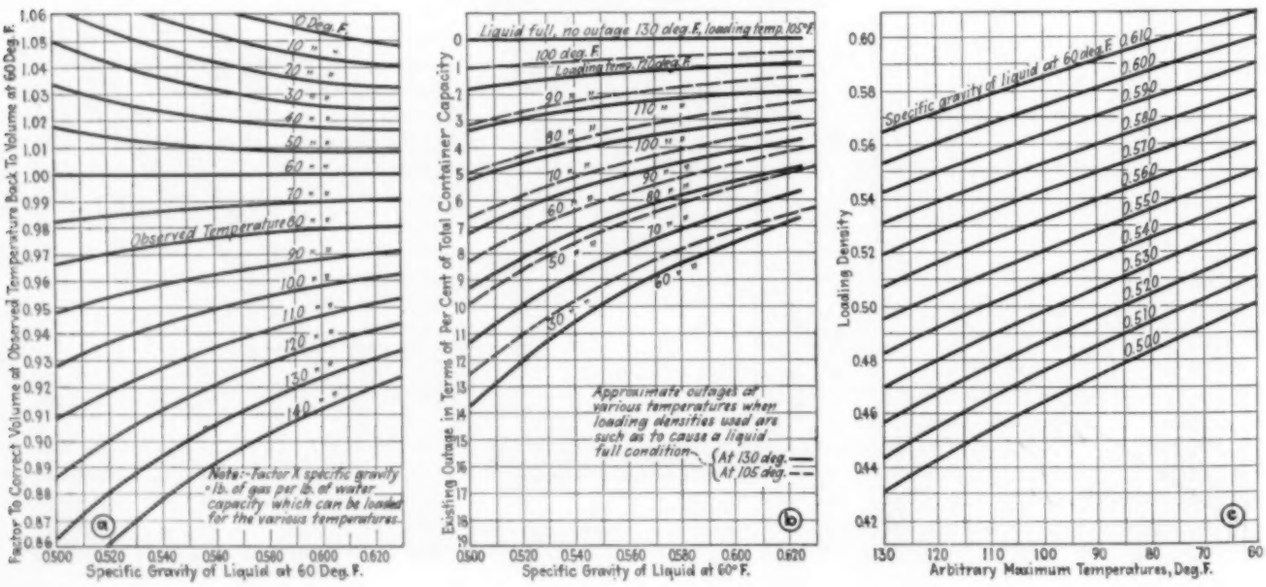
In Fig. 1 *c* are shown the maximum allowable loading densities of various products for temperatures of 105 and 130 deg. F. Inasmuch as the present I.C.C. regulations incorporate a factor of safety in the loading densities permitted for the various products, curves based on the regulations have been added to this chart to indicate the magnitude of the factor of safety employed.

Fig. 2 *b* has been prepared for the purpose of indicating the outages which will be experienced at various temperatures when the determined maximum allowable loading densities are employed. These data can be applied to all types of containers but should not be confused with the outages which will result when the present I.C.C. regulations are followed, since in this latter case the permissible densities are lower and consequently the outages existing for the various temperatures are somewhat greater than here shown. The temperatures of 105 and 130 deg. F. are considered as maximum temperatures which might be attained under normal conditions, the temperature of 105 deg. being regarded as the maximum for insulated storage tanks and tank cars and 130 deg. being regarded as the maximum for uninsulated storage tanks and small containers not protected from the direct heat of the sun. All of the information as presented in Fig. 2 *b* can be applied directly to the solution of problems involving storage and shipping, provided the distinction between the permissible densities as covered in the regulations and the maximum densities is kept in mind.

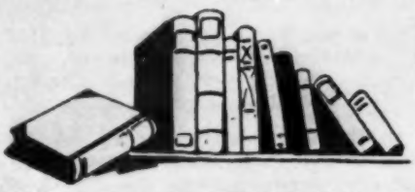
Fig. 2 *c* shows the variation in maximum allowable loading density with reference to the maximum temperature expected and requires no explanation.

The coefficient of thermal expansion of simple mixtures of hydrocarbons has previously been found to be a function of the density of the liquid; *i.e.*, the higher the Baumé gravity or the lower the specific gravity, the greater will be the coefficient of thermal expansion. It is obvious that the maximum Baumé gravity that can be had for a given vapor pressure specification is reached when the degree of separation of fractions from a mixture (rectification) is perfect. Since in the transportation of any mixed product the maximum coefficient of thermal expansion alone is of any consequence, it follows that to determine the maximum allowable safe loading it is necessary to make measurements on products having the highest possible Baumé gravity for a given vapor pressure. This procedure was followed in the present investigation, since the thermal expansion measurements were made on two-component mixtures.

Fig. 2—Determined Expansion Data (a), Outages (b), and Variations of Allowable Density With Temperature (c). See Text Above.


Factor To Correct Volume at Observed Temperature Back To Volume at 60 Deg. F.
Specific Gravity of Liquid at 60 Deg. F.
Observed Temperature
Note:-Factor X specific gravity = lb. of gas per lb. of water capacity which can be loaded for the various temperatures.
(a)
Existing Outage in Terms of Per Cent of Total Container Capacity
Liquid full, no outage 130 deg. F. loading temp. 105° F.
Approximate outages at various temperatures when loading densities used are such as to cause a liquid full condition— At 130 deg. At 105 deg.
(b)
Loading Density
Specific gravity of liquid at 60 deg. F.
Arbitrary Maximum Temperatures, Deg. F.
(c)

CHEMICAL ENGINEER'S BOOKSHELF



Refractory Technology

REFRACTORIES. By *F. H. Norton.* McGraw-Hill Book Co., New York City. 594 pages. Price, $6.

SHOULD the world suddenly be deprived of all its refractories, without the means for replacing them, there is hardly a manufacturing industry that would not find the blow a mortal one. In many industries — metallurgical plants, coke and gas works, electric utilities for example—discontinuance of operations would be immediate. Fortunately, it is with no such dire contingency that Prof. Norton faces us when he points out that this comparatively small, $70,000,000 industry of refractory manufacture is fundamental and indispensable to a very large part of our industrial structure. Rather, he dedicates his efforts to the development of the better refractories on which tomorrow's improved technology must largely be predicated.

Refractory manufacture has gone far in recent years, keeping pace with the spread of high-temperature processing. But the literature, in the main, has lagged. Hence, it was with the idea of bringing both the maker and the user of refractories up to date that the present volume was undertaken. As the author points out, the task was circumscribed by the exigencies of space—only the fundamentals of manufacture and use are treated, and these only from the standpoint of American practice. Nevertheless, Prof. Norton has succeeded in packing an enormous quantity of information into the confines of his 594 pages. Much of this has never before appeared in print.

Although the effort is aimed chiefly at the needs of the refractory maker and ceramist, the user has not been forgotten. In addition to the sections on manufacture, which the non-ceramist can well afford to read for his own information and for better understanding of the possibilities and limitations of refractories, perhaps a third of the book is given over to the properties of refractory materials, and to sections on refractory shapes, cements and plastics, all subjects of prime interest to every engineer who must depend on heat-resisting construction.

So far as the treatment is concerned, the reader will be impressed in two striking details: with the refreshingly informal style and personal character with which Prof. Norton has succeeded in clothing most of his writing; and with his exhaustive bibliography, which should serve to make an easier path for the future ceramist reader. Again, frequent signposts pointing to the roads, yet to be explored will be a feature gratefully received. And the liberal use of illustrations particularly of excellent photomicrographs, will appeal to specialist and layman alike.

Applied Colloid Chemistry

COLLOID CHEMISTRY, VOL. III: Technological Applications. By *Jerome J. Alexander.* Chemical Catalog Co., New York City. 655 pages. Price, $10.50.

Reviewed by PER K. FROLICH

THIS third volume of Alexander's large work is devoted primarily to subjects of an applied character. The first volume was published in 1926 and discussed matters of a general theoretical nature, while the second volume, which appeared in 1928, dealt with subjects in biology and medicine. The present one is made up of 42 papers contributed for the most part by experts in the individual fields. As in previous volumes, the editor has succeeded in obtaining contributions from a number of internationally known authors.

The first six papers are of a general nature and might well have been incorporated in the first volume on theoretical subjects had they been available at the time of its compilation. The next two are on catalysis and these are followed by papers on miscellaneous subjects of a more or less applied nature. As we go down the list we then come to seven contributions in the field of metals, alloys, and corrosion phenomena. Seven papers deal with petroleum and other hydrocarbon systems, three with soil chemistry, and one with wheat and its products.

Since one would be likely to do injustice by commenting on individual papers, it suffices to say that not all of them are equally good but that, taken as a whole, the volume represents a high standard of technical contributions. At least two of the papers start out by defining colloid chemistry as the science of "bubbles, drops, grains, filaments and films"; fortunately, however, none of the authors has imposed any such limitations on the discussion of his subject. Perhaps the best contributions have resulted in those cases where the authors have not felt obliged to adhere too closely to colloid concepts but have felt free to give a thorough discussion based on their own intimate knowledge of the physics and chemistry of the subject as a whole.

A compilation of this nature, made up of contributions from leading scientists and technologists, is bound to represent a valuable addition to our literature on the subjects treated, and the volume can justly be recommended as the only reference work of its kind. It will be particularly useful to those who have sufficient knowledge of colloid chemistry to enable them to study the facts and theories with a critical mind. In some instances the authors have rendered highly personal or individualistic contributions, but in most cases they have endeavored to do full justice to the existing literature in their particular field.

Principles of Flotation

FLOTATION. By *A. M. Gaudin.* McGraw-Hill Book Co., New York City. 552 pages. Price, $6.

Reviewed by B. H. STROM

THEODORE J. HOOVER, in his introductory remarks to this book, classes as one of its outstanding merits "that it much more fully than any previous attempt gives a practically complete exposition of the scientific principles underlying a process which is treating millions of tons every year." The reader is spared from wading through a long, drawn-out discourse on litigation and patent disputes—in many of the older works a hurdle to be cleared before the main topic could be approached. After a short chapter on essential historical data, the author plunges into what he terms "a technological record of the art, built on a scientific foundation and framed by its economic background."

Chapters II to IV present fundamental chemistry, with discussion of the physical phenomena encountered in the process; chapters V to VII, XIV, XV, XVIII, and XIX deal with general technology and treat such subjects as reagents, froth production, crushing, grinding, and classification, flotation machines, mill design, and testing; chapters VIII to XIII discuss detailed technology and practice, describing specific installations, and illustrating the various problems by well-chosen examples from the field. The economics

of the art, discussion of cost, choice of method to use, effect of the process on mining and metallurgical operations comprise chapters XVI, XVII and XX.

The author refrains from a lengthy discussion of such subjects as crushing, grinding, classification, or a detailed description of machinery, so that more space may be devoted to a thorough treatment of the fundamental processes. Too much emphasis can hardly be placed on this side of flotation. From the chaos that existed a few years ago, definite theories are evolving, mechanical problems are being solved, the action of flotation reagents is gradually becoming understood; and, from the thousands of compounds available, the operator may, by scientific deduction, select those that best serve his specific need. In this work—closely connected as it is with and dependent upon the most advanced studies of the structure of matter and of intermolecular and interatomic forces—the author has been one of the pioneers. This probably explains why his presentation of this important but difficult phase of the art is so clear and so well executed that the subject becomes truly fascinating.

The technological development of the process is illustrated by flowsheets selected to present typical applications for numerous types of ores. Six plants treating copper sulphide ores are described, seven handling lead-zinc sulphides. Flotation of oxidized ores, and of rare minerals, including silver and gold ores, is also treated in detail. An interesting chapter is devoted to the flotation of non-metallic minerals; although development is still in the early stages, and a correct perspective is difficult to obtain, the results achieved in this field give promise of changes in practice that may become almost as far-reaching as those that have taken place in metallurgy. With a better understanding of the functions of reagents, separation of almost any combination of minerals comes within the realm of the possible. Although the problems here encountered may appear to be of a more difficult nature than those that confronted the metallurgist in the early days of the flotation process, accumulated experience and better understanding of the underlying principles should greatly hasten progress in the non-metallic field.

Physico-Chemical Practice

TEXTBOOK OF PRACTICAL PHYSICAL CHEMISTRY. By *K. Fajans* and *J. Wüst*. Translated by *Bryan Topley*. Dutton & Co., New York City. 233 pages. Price, $4.95.

Reviewed by HUGH S. TAYLOR

AS Prof. Donnan remarks in his foreword, this book covers "a very wide field and is characterized by many highly commendable features." The book represents a very thorough course in physical chemical measurements and is compiled with that care and precision which we are accustomed to expect from Prof. Fajans.

The contents of the volume are for the most part classical physical chemical exercises. The more unusual features are those dealing with optical measurements, radio activity, and electrometric methods. It is a personal view of the reviewer that the section dealing with velocity of reactions is not abreast of modern developments in this field. The subject of reaction kinetics offers an opportunity to introduce the student to the technique of gas manipulation and the production of vacua. Only in isolated instances, however, have such experiments found their way into physico-chemical texts. The orientation of modern physical chemistry demands that increasing attention should be given to this phase of the subject. In view of the sale price of classical texts of practical physical chemistry such as that by Alexander Findlay, the price of the present volume constitutes its principal disadvantage.

Chemical Patent Law

PRINCIPLES OF PATENT LAW for the Chemical and Metallurgical Industries. By *Anthony William Deller*. Chemical Catalog Co., 1931. 483 pages. Price, $6.

Reviewed by J. S. NEGRU

IN this informative work on patent law, relating especially to the chemical and metallurgical industries, the author expounds systematically the formulation of patent specifications and claims, the prosecution of the patent applications, and other problems dealing with the subject. He has coordinated in one single volume complex and intricate theories of patent law in a style intelligible to technical men. Although this book refers mainly to the American industries, it constitutes at the same time a useful guide for all of the other industrial countries.

The 12 chapters deal with the history, theory and nature of patents; classes of patentable inventions; persons entitled to letters patent; principles of patentability; acquisition and termination of letters patent; remedy of defective patents; form and construction of patents; infringement of letters patent; suits for infringement; incidents of ownership of patents; commercial phases of patents and foreign patents. An appendix of about 50 pages contains very interesting tabulated statistics and other information germane to the chemical and metallurgical industries. In addition, the detailed subject index and the tabulation of the legal cases cited make it an easy reference book for chemists, metallurgists, research directors, managers and executives of chemical and metallurgical enterprises, as well as for patent engineers and attorneys.

The reviewer feels that the author has made his subject so clear and interesting that it will not be amiss to quote a paragraph from Dr. Baekeland's foreword: "My own information about patent laws has been acquired slowly, after long years of experience, and at the cost of some expensive blunders. I might have avoided all this if I had been able to avail myself of a book like Dr. Deller's."

Newly Arrived

CHEMISCHES FACHWÖRTERBUCH. Vol. II—English-German-French. By *A. W. Mayer*. Verlag Otto Spamer, Leipzig, 1931. 943 pages. Price, 75 M., bound.

In this commendable effort to produce a new, extensive dictionary of chemical terms for the three leading languages, the first volume of several years ago is probably of greatest value for English readers. Next in importance will be the prospective third volume: French-German-English. For completeness' sake and for special cases, the present second volume will also be desirable here, although less than abroad. The completeness strived for originally has again been achieved in this new addition; especially helpful is the absence of obligatory cross-reference, although duplicate references properly list the synonyms.

AUSGEWÄHLTE METHODEN FÜR SCHIEDSANALYSEN VON ERZEN, METALLEN, etc. Gesellschaft Deutscher Metallhütten-und Bergleute, e. V., Berlin, 1931. 457 pages. Price, 20 M.—A revision of the work that originally appeared in two volumes in 1926. The content is an authoritative, compendious selection of analysis methods for all commercial non-ferrous and steel-hardening metals—a tribute to the concerted efforts of the society's chemical section, founded in 1920.

PROBENAHME VON ERZEN . . . METALLEN UND LEGIERUNGEN. Gesellschaft Deutscher Metallhütten-und Bergleute, e. V., Berlin, 1931. 108 pages. Price, 4 M.—A very desirable treatise on sampling of metallic substances with résumés of practical tolerances, secondary metal trade in Germany, and American standards on secondary metals.

OXYACETYLENE WELDING AND CUTTING. By *Stuart Plumley*. Second edition. University Printing Co., Minneapolis, Minn., 1931. 410 pages. Price, $5—An expanded edition of a very thorough instruction course for welders and designers who must rely on welding. In addition to the "course," there is a summary of data and legal technicalities on the subject.

QUANTITATIVE CHEMICAL ANALYSIS. By *Frank Clowes* and *J. Bernard Coleman*. Thirteenth edition. P. Blakiston's Son & Co., Inc., Philadelphia, Pa., 1931. 605 pages.—To the original book, published in England in 1891, a section on electrometric analysis and a list of useful reference books has been added.

SYMPOSIUM ON WELDING. American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa., 1931. 152 pages. Price, $1.75.—Papers on welding read at the Pittsburgh regional meeting of the society last March.

SELECTIONS FROM RECENT LITERATURE

HEAT LOSS IN BURIED PIPE. I. S. Cammerer. *Archiv für Wärmewirtschaft*, February, pp. 29-34. In a systematic study of the heat losses from bare and insulated pipe buried in the ground, measurements were made of the thermal conductivity of various soils, the effect of moisture, the effective range of temperature effect around the pipe, and the efficacy of insulating layers. It was found that heat losses can be calculated from the usual equations for heat flow through cylinders, assuming the effective temperature range in the soil to be 3 meters. Whereas bare pipes dry out the surrounding soil quite rapidly, insulated pipe has little effect on soil moisture. The protective effect of the soil makes the optimum thickness of insulation less than it would otherwise be; as compared with pipe in open air, the thickness may be decreased about half. The heat loss from bare pipe is calculated to be only about twice as great as from insulated pipe. The 3-meter limit of effective range is only an arbitrary value for calculation purposes; temperature effects may actually extend as far as 5 meters, and must be considered with respect to possible effects on plants, structural parts, etc. On account of the permissible reductions in thickness of insulation, the buried pipe line has an advantage in installation costs over lines exposed to air in a trench or above ground. Curve charts and numerical tables show moisture distribution in the soil, temperature effects, comparisons of thickness of insulation for a like thermal effect on buried and exposed pipes, thermal conductivity of soils, comparative heat losses of bare and insulated pipe, and other data.

PUMPING LIQUIDS. G. Lesch. *Zeitschrift des Vereins deutscher Ingenieure*, Jan. 30, pp. 113-4. In pumping liquids to meet a variable demand, if the quantity is very large the problem of fluctuating requirements can be met by use of a series of pumps of graduated capacities, a suitable number of pumps being cut in or out of operation to meet increases or decreases in demand. But in smaller installations or when a finer degree of precision is wanted, variable capacity in a single pump becomes important. In this connection, a comparison has been made of costs, and performance of three systems for controlling the output of motor-driven pumps. The first is the Brown-Boveri-Scherbius system for controlling the speed of the pump; an example is a centrifugal pump, driven by a 700-hp. motor with electrical means for varying the speed between 1,320 and 1,680 r.p.m. in 20 stages. The second system involves the use of variable resistance in the circuit of an asynchronous motor; it is effective, giving speed variations between 81 and 100 per cent of full capacity, but it introduces energy losses which increase as the degree of speed control increases. The third system is one in which hydraulic control is effected by throttling down the cross-sectional area of the pumping outlet. This method also introduces energy losses, whereas in the first system such losses are practically eliminated. Curve charts show the degree of pumping efficiency, the yield factor, and the energy losses for each of the three systems.

VIBRATING SCREENS. Hans Binte. *Zeitschrift des Vereins deutscher Ingenieure*, Jan. 23, pp. 85-6. The new resonating type of vibrating screen, developed by Schieferstein from the conventional prior design of such screens without the resonating feature, is so arranged that the kinetic energy of the vibrating screen frames is not lost. An elastic medium is provided, which takes up this energy and recovers it for utilization. These screens are made in double and triple units. In one design of the triple units, the three screen frames are superimposed, and non-harmonic damping vibrations is effected by means of coil springs made of chrome-nickel steel. In another triple unit, only one screen frame is driven and the other two are disposed in freely vibrating arrangement. One screen is placed partly above the other two for prescreening, and the material moves in opposite directions over the other two screens. The advantages of resonance are that the screens and the building are not subjected to the wear and deterioration caused by damping the vibrations. A photograph is shown of the triple unit with superimposed screens, which is particularly suitable for use with rock salt and like materials to be screened to definite sizes. Drawings are shown of two other triple-screen units, not of the superimposed type.

RIGID FILTER AIDS. M. Dolch. *Chemische Apparatur*, Feb. 10, pp. 27-8. The "candle" type of filter, which has hitherto been only for laboratory use, is now being successfully translated into plant practice. This brings the rigid filter aid into industrial use and opens up many possibilities for improvements in large-scale filtration. By close control of particle size in the raw material and of the pressure applied in making finished shapes, and by careful application of every precaution known to the art in firing the shapes, rigid filter aids have been produced which combine the necessary high mechanical strength with excellent filtration performance and ease of regeneration. Kieselguhr was first tried as raw material, but its lack of uniformity of pore size and its complex pore formations render regeneration very difficult. Best results may be expected from shapes made up from round particles of uniform size and uniformly distributed in the binder. High resistance to pressure is quite necessary, not only for vacuum and pressure filtrations but also for use of compressed fluids for cleaning. Progress in this field is not limited to ceramic compositions; use of organic binders (synthetic resins or the like) has certain manufacturing advantages and yields shapes in which porosity attains a high degree of uniformity. Hard rubber is a material which offers the advantages of acid and alkali resistance in combination with desirable mechanical properties. Further developments in rigid filters need close cooperation between producers and the designers of chemical engineering equipment.

HEAT EXCHANGER. Otto Krebs. *Chemische Fabrik*, Jan. 27, pp. 25-6; Feb. 3, pp. 34-5. In recovering liquids from dilute solutions by distillation, some means for retaining the sensible heat of the residue must be provided to avoid excessive heat losses. A vertical heat exchanger, which is particularly useful in continuous vacuum distillation is described. A leading example of the effective use of this heat exchanger is in benzol recovery, in which the heavy oil absorbent is heated up to about 145 deg. C. to expel benzol vapors. Whereas simple cooling of the scrubbing oil, without heat recovery, makes operating costs excessive, suitable application of heat exchangers of a size comparable with the coolers permits distillation on a much more economical basis. The vertical type of heat exchanger provides smooth, uniform oil flow because the incoming hot oil is evenly distributed over the heat exchanger area at the top and gradually flows downward. In order to equalize the rate of flow of the two oil streams through the exchanger, the volume around the tubes should be about equal to the volume inside the tubes. Actual operating figures, taken from benzol distillation, are given to illustrate the performance of the exchanger under various conditions and with varying loads. Some of the difficulties likely to be encouraged in the practical use of the apparatus are cited, and remedies are discussed.

CONTINUOUS DIFFUSION. J. Perard. *Bulletin de l'Association des Chimistes de Sucrerie*, November, pp. 499-508. Whereas the newer methods and apparatus for continuous operation now practically dominate distillation practice, diffusion as practiced in the beet sugar industry is still almost entirely a matter of batch operation. The New Olier continuous diffuser has performed well in a practical trial lasting more than a month and bids fair to be an important contribution to the art. The new apparatus comprises a series of six vertical columns, connected at the bottoms and at the tops to form a closed space, an endless conveyor circulating in this space, and suitable devices for maintaining even tension on the con-

veyor chain, for safety and for automatic control of the process. The principle which is followed is the same as in prior diffusers: namely, countercurrent extraction with hot water or with diluted vinasse. The first cost of an Olier installation is relatively lower than for earlier types of diffusers; diffuser and stills can both be housed in the same building. The test run which has been made indicates that the new continuous system is superior to batch diffusers in its smooth mechanical operation, low labor cost in operation, low steam consumption, simplified treatment of the pulp, low sugar losses, thoroughness of extraction of sugar from the beets, automatic control features, and adaptability to optimum operating conditions.

CONTROLLING LIQUID FLOW. H. Staffehl. *Chemiker-Zeitung,* Jan. 27, pp. 76-8. The feature of automatic operation causes float valves to differ much from other valves and stopcocks in construction. For pressures up to about 4 atm., a simple lever between float and closure is adequate; for pressures from 4 to about 8 atm., a construction is provided in which the float actuates the closure through a screw, of which the pitch is sufficient to make the valve sensitive to small motions of the float. Such a valve operates smoothly even under wide pressure fluctuations; quiet, uniform closure is assured by a double cone type of orifice-closing device. Cast iron is used in valves for ordinary service; suitable corrosion-resisting metals are used for corrosive (acid or alkaline) liquids; for superheated steam, nickel surfaces may be used in exposed parts. Special float valve constructions are available for maintaining constant level in tanks, sumps, vats, etc., to prevent overflow and accidental emptying. Others control the flow of liquids into tanks not actually entered by the pipe line. For pressure vessels, or where ready accessibility to the valve is required, there are designs with the valve outside and the float inside the vessel. For some purposes the position of the float is made adjustable to different levels. For thick liquids or sludges—*e.g.*, cement or lime slurries, paper pulp, molasses, tar, etc.—there is a special construction in which no moving part is exposed to the stream of liquid except the thoroughly smooth closure cone; thus incrustations and clogging are prevented. When liquid-tight closure is not required, throttling devices to control rate of flow can also be adapted to the float valve principle.

THERMAL INSULATION. I. S. Cammerer and W. Dürhammer. *Archiv für Wärmewirtschaft,* January, pp. 15-6. In granulated cork insulation for refrigeration, even a small water content causes a considerable increase in thermal conductivity. A study has therefore been made of the modes of access of water or water vapor in insulating layers. It was found that cork and bitumen composition slabs, commonly used for low-temperature insulation, contain up to 3.5 volume-percentage of water, independently of whether they are covered with cement or pitch. Such a water content raises the thermal conductivity considerably above the limits usually stated for such insulation. Under the influence of the temperature gradient, moisture migrates from the outer walls toward the colder interior and collects in the felt layer. Where a waterproof finish is applied instead of felt, water can evaporate from the smooth surface and draw water from the interior layers by capillarity, so that it does not collect as it does in a felt layer. There is no apparent effect of age of the insulation.

AUTOMATIC TEMPERATURE CONTROL. Joh. Fuchs. *Chemische Fabrik,* Feb. 17, pp. 49-52. Of the two principal types of automatic temperature control instruments, those using some kind of heat detector have many more applications in industrial process control than those operating with a time relay. A heat detector may be a metal contact element (metal against metal or metal against a ceramic body), a thermoelement, or merely the resistance changes in the heating element. The metal contact pairs which have found the most applications are aluminum:invar, copper (or brass):invar (or quartz), steel (or nickel):quartz, and chromium-nickel:porcelain. Quartz and porcelain permit higher temperature ranges than do bimetallic pairs. Control of electric heating units by turning the current off and on periodically is quite satisfactory for small units; but in large units some expedient is needed for turning off or on a part—not all—of the current. Manual control may be combined with the use of a contact thermometer, but this has several drawbacks. The need is therefore met by a contact thermometer with a double contact, for use with a pair of electric circuits in large heating units. The accuracy of a contact thermometer device depends on the construction and length of the heat detector, and on the ratio of its heat capacity to that of the material in which it is placed. Most instruments are accurate within about 2 to 3 deg. C.

Recent Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from bureau responsible for its issue.

Flotation Reagents—South Africa, by DuWayne G. Clark. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 359; mimeographed.

Bibliography on Dry Cleaning, by Alvin E. Johnson. Bureau of Foreign and Domestic Commerce Textile Division Special Bulletin 613; mimeographed.

Wages and Hours of Labor in Cane-Sugar Refining Industry, 1930. Bureau of Labor Statistics Bulletin 547; 10 cents.

Cotton Cloth for Rubber and Pyroxylin Coating. Bureau of Standards Commercial Standard CS32-31; 5 cents.

Crude Petroleum and Its Liquid Refined Products. U. S. Tariff Commission Report 30, Second Series; 25 cents. Report of the Commission to the House of Representatives comparing domestic and foreign costs of production.

Fatalities in California Petroleum Industry, 1930, by R. L. Marek. Bureau of Mines Report of Investigations 3156; mimeographed.

Physical Chemical Properties of Methane, by H. H. Storch. Bureau of Mines Information Circular 6549; mimeographed.

Acidity of Drainage From High Pyritic Coal Areas in Pennsylvania, by R. D. Leitch. Bureau of Mines Report of Investigations 3146; mimeographed.

Consumption of Primary Tin in the United States During 1930, by John B. Umhau. Bureau of Mines Information Circular 6564; mimeographed.

Explosive Shattering of Minerals as a Substitute for Crushing Preparatory to Ore Dressing, by R. S. Dean and John Gross. Bureau of Mines Report of Investigations 3118; mimeographed.

Consumption of Explosives in December, 1931 (With Final Figures for the Year 1931), by W. W. Adams and L. S. Gerry. Bureau of Mines Health and Safety Statistical Surveys E. 6; mimeographed.

Physical Testing of Explosives, by Charles E. Munroe and J. E. Tiffany. Bureau of Mines Bulletin 346; 35 cents.

Regulations Governing Manufacture, Storage, Loading, and Handling of Military Explosives and Ammunition at Establishments of the Ordnance Department, U. S. Army. War Ordnance Department. Ordnance Safety Manual 7224; 60 cents.

Defense Against Chemical Attack. War Department Basic Field Manual, Volume 1, Chapter 8; 15 cents. From Chemical Warfare Service.

Commerce Yearbook, 1931, Vol. II—Foreign Countries. Bureau of Foreign and Domestic Commerce bound volume; $1.

Australian Cream of Tartar and Tartaric Acid Industry, by H. P. Van Blarcom, Assistant Trade Commissioner, Bureau of Foreign and Domestic Commerce, Chemicals Division Special Circular No. 366. Statistical trade review.

Sulphuric Acid—Mimeographed statistical statement from Bureau of the Census. Summary for December and for calendar year 1931 of production, stocks, and shipments by fertilizer manufacturers.

Superphosphates—Mimeographed statistical statement from Bureau of the Census. Summary for December and for calendar year 1931 of production, stocks, and shipments by fertilizer manufacturers.

Coal-Tar Dye and Synthetic Chemical Imports—Bureau of Foreign and Domestic Commerce; mimeographed summary I-8000. Gives data for January, 1932, and summarizes imports for calendar year 1931.

Mineral Production Statistics for 1931—Preliminary mimeographed statements from Bureau of Mines on: Lime; liquefied petroleum gases; and petroleum, petroleum products, and natural gasoline.

Mineral Production Statistics for 1930—Separate pamphlets from the Bureau of Mines on: Asbestos, by Oliver Bowles and B. H. Stoddard, 5 cents; Manganese and Manganiferous Ores, by Robert H. Ridgway, 10 cents; Tin, by Charles White Merrill, 5 cents; Cobalt, Molybdenum, Tantalum, Titanium, and Various Rare Metals, by Paul M. Tyler and Alice V. Petar, 5 cents; Lime, by A. T. Coons, 5 cents; Barite and Barium Products, by R. M. Santmyers and B. H. Stoddard, 5 cents; and Stone, by A. T. Coons, 10 cents.

THE PLANT NOTEBOOK

Calculating Washing Efficiency in Countercurrent Decantation

By M. T. Sanders
Atlas Powder Co.
Wilmington, Delaware

IN CALCULATING the expected washing efficiency of a countercurrent washing system, such as the Dorr, it is customary to form and solve the set of simultaneous equations for the particular case being considered. In most instances, a much simpler method is to make use of a general equation, the derivation and application of which are outlined here. For ready solution of the problem a table and chart are provided which make it an easy matter to calculate, for any given washing efficiency, the quantity of wash water required for various numbers of thickeners. Similarly, given the number of thickeners and the quantity of wash water available, the washing efficiency is readily determinable. Then, knowing the cost of power, water and equipment, the engineer is in a position to determine the conditions for minimum washing cost.

In its simplest form, a countercurrent washing system is arranged as in Fig. 1. In such a case, the sludge to be washed enters the last (lowest) thickener, from which the solution to be recovered is removed. Wash water is added in the first thickener, from which the washed sludge is removed. This arrangement suffices in many cases, although it is frequently desired to insert filters or agitators between certain of the thickeners, as, for example, in some of the modern causticizing layouts. In such cases the method given below can be applied to the individual sections of the washing system.

The general equation is derived by considering the flow of materials into and out of the system, and in its final form must be expressed only in terms that represent starting or finishing quantities. Since the solids of the sludge go through the system presumably unchanged, they can be disregarded in the calculations. From the definition of terms, the quantities entering and leaving any thickener are readily determined and these have been noted on Fig. 1. From these quantities it is apparent that the equation of entering and leaving materials for any thickener is of the form: $WX_n + WSX_{(n-2)} = (1+S)WX_{(n-1)}$ which expresses the balance of materials in thickener $(n-1)$. By setting up similar equations for each thickener and solving them simultaneously, it is possible to derive an expression for the concentration of dissolved materials per pound of water in the nth thickener and to express this only in terms of S, n and the known concentrations, X and X_o. This equation is:

$$X_n = \left(\frac{S^n-1}{S-1}\right)(X_1 - X_o) + X_o \quad (1)$$

But the balance of materials for the nth thickener, as set up from the quantities shown in Fig. 1, is

$$(M + WS - W)X_n + WX_n = MY + WSX_{(n-1)} \quad (2)$$

To eliminate unknowns from this equation it is merely necessary to substitute in it the values of X_n and $X_{(n-1)}$, which are obtained directly from equation (1). Simplifying the equation so obtained and multiplying both sides by W, we find that:

$$WX_1 = \frac{M(Y - X_o)}{\left(\frac{S^n-1}{S-1}\right)\left(\frac{M}{W} + S - 1\right) + 1} + WX_o \quad (3)$$

This is the general equation which gives the quantity of dissolved material going to waste with the washed sludge discharged in each unit of time from thickener (1). In practice the equation is generally simplified by the assumption that the dissolved material in the entering wash water, X_o, is zero.

In using the equation it is generally necessary to find the value of S for varying numbers of thickeners, so as to give a certain desired washing efficiency. There are, of course, various possible solutions, depending on the number of thickeners that can be used. It is evident that a recasting of the equation will make it more readily capable of solution. Solving for $\left(\frac{S^n-1}{S-1}\right)$ and letting X_o equal zero, we have:

$$\left(\frac{S^n-1}{S-1}\right) = \frac{MY - WX_1}{WX_1\left(\frac{M}{W} + S - 1\right)} \quad (4)$$

Nomenclature

M = Pounds of water in the sludge entering the system per unit of time.
W = Pounds of water in the sludge leaving any thickener or leaving the system per unit of time.
S = Pounds of wash water entering the system per pound W.
WS = Pounds of wash water entering the system per unit of time.
X = Pounds of dissolved material per pound of water in any thickener: i.e., $X_{(1)}$ = value of X in thickener (1); $X_{(n)}$ = value of X in thickener (n).
X_o = Pounds of dissolved material per pound of wash water entering the system (generally considered zero).
Y = Pounds of dissolved materials per pound of water in the sludge entering the system, per unit of time.
MY = Pounds of dissolved materials entering the system with the sludge per unit of time.
n = Number of thickeners.

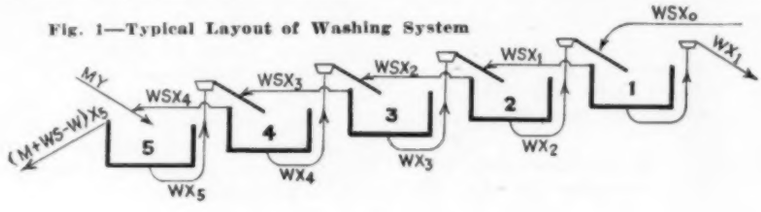


Fig. 1—Typical Layout of Washing System

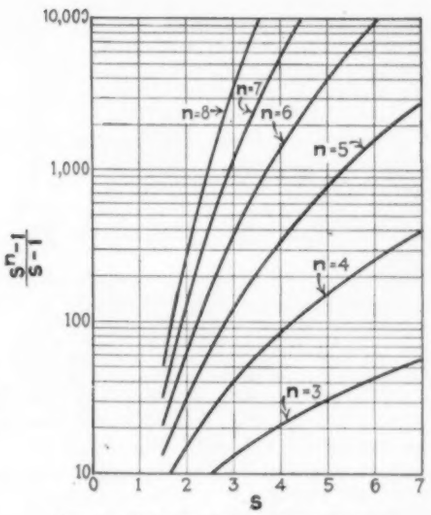


Fig. 2—Values of Equation Factor

Values of $\frac{S^n - 1}{S - 1}$ for Values of S and n

n \ S	1.0	1.5	2.0	2.5	3	4	5	6	7
2	2	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0
3	3	4.75	7.0	9.75	13.0	21.0	31.0	43.0	57.0
4	4	8.125	15.0	26.375	40.0	85.0	156.0	259.0	400.0
5	5	13.19	31.0	65.44	121.0	341.0	781.0	1,555.0	2,801.0
6	6	20.78	63.0	163.1	364.0	1,365.0	3,906.0	9,331.0	19,608.0
7	7	32.2	127.0	407.1	1,093.0	5,461.0	19,531.0	55,987.0	137,251.0
8	8	49.3	255.0	1,017.0	3,280.0	22,845.0	97,656.0	335,923.0	960,800.0

In the above equations, the terms, W, M and WS, have been taken as representing pounds of water, and the terms, X and Y, as representing pounds of soluble material per pound of water. It was assumed that the water in the sludge leaving each thickener per unit of time was constant. If, instead, the solution leaving each thickener with the sludge is assumed to be constant and equal to W, then the terms X and Y represent the fractional concentration of soluble material in the respective solutions.

Values for $\left(\frac{S^n - 1}{S - 1}\right)$ for several possible values of S and n are given in the accompanying tabulation and are plotted against S in Fig. 2. Since, with the exception of S, all the terms in the right-hand side of equation (4) are stated in the problem, the simplest solution of the equation is obtained by calculating the values of this right-hand term of equation (4) for several values of S and plotting the results against S on the chart of Fig. 2. Then a line drawn through these points will intersect the several curves, showing at each intersection the required value of S for the various numbers of thickeners.

With this information, the calculator is then ready to balance the costs of power, equipment and wash water and to determine the most practicable installation for any set of conditions.

In the case where $M = W$, which is the one considered by Noel Deer (*International Sugar Jour.*, **33**, 1931, pp. 167-71) in his study of the extraction of sugar in a cane crushing and washing system, equation (3), letting X_0 equal zero, reduces to:

$$\frac{WX_1}{MY} = \left(\frac{S - 1}{S^{n+1} - 1}\right) \qquad (5)$$

In another special case the overflow of the thickener $(n-1)$ is fed into a reaction tank together with M lb. of water and MY lb. of soluble material per unit of time. The outflow from this reaction tank is fed into thickener n. The equations under these circumstances are identical with those already given, since in both cases the feed to the nth thickener is $MY + WSX_{(n-1)}$, the overflow from the nth thickener is $(M + WS - W)\,X_n$ and the soluble material removed with the sludge is WX_n.

Factors Governing Life of Conveyor Belts

By C. F. Conner
B. F. Goodrich Rubber Co.
Akron, Ohio

ENGINEERS have long sought a rational formula for calculating reasonable service to be expected from a conveyor belt. However, there are so many variable factors that this has been impossible. Perhaps the best way of expressing the life of conveyor belts is the cost of belt per ton delivered during the total life of the belt. That this figure will vary widely with the type of service is illustrated in the adjoining tabulation, which has been compiled from records considered satisfactory by the users.

Factors governing the life of conveyor belts fall into three groups: Those depending on the service required, which are not subject to control; those under the control of the designer and manufacturer; and finally those under the control of the operator. Many of the uncontrollable factors are of considerable importance. One of these is length, which affects the life in various ways. Roughly speaking, the total tonnage delivered during the life of the belt is directly proportional to its length; but since the first cost of the belt is also directly proportional to its length, the cost of the belt per ton delivered has a tendency to be uniform regardless of the length. On the other hand, this is not true if the belt has more than one loading point, nor if it is handling hot materials.

Performance of Rubber Conveyor Belts

	Belt Length, Feet	Belt Width, Inches	Total Tons Handled	Dollars* per 1,000 Tons
Ore	610	48	37,000,000	1.01
	770	48	11,744,000	0.42
	290	42	5,228,181	0.28
	111	30	4,647,000	0.097
Coal	2,400	48	19,000,000	0.76
	1,775	48	4,400,000	1.70
	190	36	4,540,000	0.09
Coke	925	42	.....	7.75
	540	36	.....	2.00
	1,000	42	.....	3.90
Stone	723	30	.....	1.00
	450	36	.....	.80
	280	24	.....	.65

*Based on belt prices now current.

Belt width and weight of material both influence tonnage cost, and each in a similar manner: Increase in the factor increases the handleable tonnage and decreases the cost. Other factors, such as heat, corrosion, oil, abrasion, size of material and lift, all tend to increase tonnage cost as the factors become more severe. Lump material usually wears a belt faster than fine material. High lifts increase both unit cost and wear.

Designers and manufacturers have control over a number of the life-determining features in the conveyor installation. For example, the design of the loading chute has an important influence on wear. The ideal loading condition is for the material to be deposited on the belt at the same speed and in the same direction as the travel of the belt. When the load is permitted to drop any considerable distance, heavy lumps may rapidly cut the belt to pieces.

Protective devices are important factors in belt life. These include decking, brushes and other means of preventing material from spilling on the return side of the belt or clinging to the pulleys. Proper choice of the cover thickness has a considerable bearing on tonnage cost. Thickness should be properly balanced to meet the conditions of service so that the cover will neither outwear the carcass nor be worn out while the carcass is still good. In some installations material seems to wear the belt only in the middle of the top cover. The remedy here is to use a belt with an extra thickness of cover in the middle, either a "reinforced cover" with an extra rubber strip along the middle or a belt of "stepped-ply" construction. The first is preferable where the belt operates under considerable tension. In the second construction, the two upper plies of fabric extend only part way in from the edge, the middle being filled with additional rubber.

The quality of the belt, which is determined largely by the quality of rubber used for impregnating the fabric and for the covers, is also an important consideration. It is often poor economy to use too high a quality in cases where the belt is especially liable to damage.

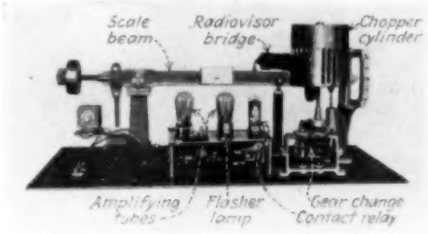
Design of the conveyor also has a considerable bearing on belt life. Manufacturers of this equipment will generally supply the best construction, provided the buyer does not force skimping. A few dollars saved in the design of a loading chute or in the installation of brushes may take its toll ten times over in wear of the belt. Another point to be remembered is that a belt which travels faster than is necessary to handle its load cannot be expected to deliver as much tonnage as a belt well filled. Delivery of a small load can wear the belt just as rapidly as a larger load.

Once the conveyor is in the hands of the operator, other controllable factors enter which may decrease belt life. Many belts are hopelessly damaged during installation or may run crooked due to failure to cut the belt square at the joint. Correct alignment of idlers and trippers avoids crooked running and edge injury. Belts that are run too tight are very liable to injury. Excessive tension may be avoided by pulley lagging or other corrective measures. Lack of proper lubrication is another fertile cause of belt injury, for stuck idlers wear sharp and cut the belt. Still another danger point is the accumulation of material on pulleys. The purchase of cleaning devices represents a good investment.

EQUIPMENT NEWS
FROM MAKER AND USER

Photo-Electric Integrator

IN A RECENT improvement in the Telepoise integrating conveyor scale, its manufacturers, John Chatillon & Sons, 85 Cliff St., New York City, have eliminated all mechanical connection between the weighing and integrating mechanism through the use of a photo-electric cell. In the earlier form of this scale, described in the June, 1929, issue of *Chem. & Met.*, position of the scale beam, which was proportional to the instantaneous load on the belt conveyor, was translated mechanically into a series of electrical impulses, the number of which per unit of time was proportional to the load. These impulses were then integrated in terms of cumulative load by an electric



Details of Photo-Electric Integrator

counter. In the new mechanism, shown in the accompanying halftone, the scale beam carries a Burgess Radiovisor Bridge (*Chem. & Met.*, p. 606, Oct., 1931) and a small light source. One is placed inside, the other outside a "light-chopper" cylinder which is driven at a speed dependent on the speed of the conveyor belt. The light chopper contains 32 slots of progressively varying length through which the light beam travels to the photo-electric cell.

Operation of the integrating mechanism is as follows: At zero load on the belt the scale beam is at the top of its travel and no light penetrates the chopper cylinder. At full load the scale beam is at the bottom of its travel and light passes each of the 32 slots during one revolution of the chopper. At intermediate weights, a greater or lesser number of slots is uncovered and the number of light impulses reaching the photo-electric cell is directly proportional to the load. Electric impulses given off by the cell are then strengthened by electron tubes and the impulses fed to the electric counter which serves as the integrator. The rate of rotation of the chopper generally is such that, at full load, one contact will be made for every foot of belt travel.

Balancing of the device is accomplished by connecting a flasher lamp to the photo cell system and using change gears to slow down the rotation of the chopper until the impulses can be counted. With the belt empty, the beam is loaded to its mid position. At this rate, 16 flashes per cycle should occur. If this is not the case, the beam can be balanced by a movable poise until correct indication is obtained.

❖

Improved Gyrating Screen

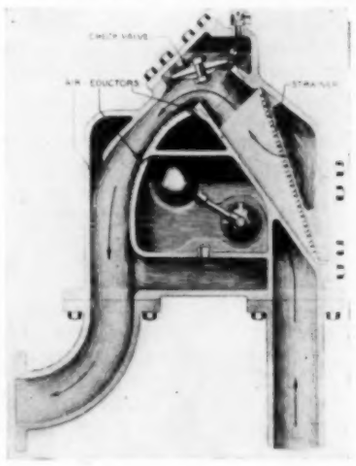
SEVERAL new features have been introduced by Simplicity Engineering Co., Durand, Mich., in its new "Model B" 4x8-ft. gyrating screen. These features include mounting the motor directly on the gyrating shaft without couplings; complete interchangeability of shaft assemblies in two hours or less; resilient rubber mountings in place of springs; easy screening-angle adjustment; and easy adjustment of the balanced compensator. Screens are available also with flat or V-belt drives.

❖

Suction-Line Primer

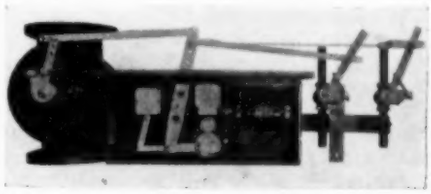
PRIMING of centrifugal pumps may be accomplished with a new suction-line primer developed by Barrett, Haentjens & Co., Hazleton, Pa. It combines in one compact casing a check-valve, strainer and air removing device. It is available in various sizes up to a capacity of 1,500 g.p.m. for a maximum operating head of 200 ft. When provided with a special control panel, it makes possible automatic operation of the pump with complete protection against loss of water, air leaks and breaks of the liquid column. The primer is shown in an accompanying illustration.

Improved Centrifugal Pump Primer



Motor-Operated Controller

TYPE 303 is the designation of a new multi-position, motor-operated controller announced by the Automatic Temperature Control Co., 34 East Logan St., Philadelphia, Pa. This controller may be used for either two- or three-position operation and in the latter set-up, either three or four valve positions can be obtained by simple mechanical adjustment of the limit switch. By this means the controller will automatically match fuel supply to the



Three-Position, Motor-Operated Controller

requirements at either three or four rates. The controller is made in three sizes to contol different sorts of valves.

This company has also announced a new motor-operated valve known as Type 1, the controller unit of which is capable of handling valves of either the rotary or slide-stem type. This is a two-position valve, operating between high and low limits under control of a temperature or other regulator.

❖

Combustion Indicator

AUTOMATIC indication of furnace conditions is provided by the new Hays automatic combustion indicator, announced by the Hays Corp., Michigan City, Ind. This instrument is a mechanical Orsat apparatus and is similar to this company's recorders. In addition to indicating CO_2, the instrument may be equipped to indicate various combinations of flue gas temperature, and draft at one or more points.

❖

Refractory Bonding Mortar

"PYRO-MORTAR" is the name of a new dry refractory cement supplied by the Quigley Co., 56 West 45th St., New York City. It is said that the material has a fusion point equal to that of the best firebrick and that it sets slowly and exerts a strong bond. According to the manufacturer, it neither chips, cracks, shrinks, nor swells after drying or in service. It is used, mixed with water as required, in all sorts of furnace construction and repair.

Chemical Stoneware Equipment

REDESIGN of its entire line of centrifugal pumps has recently been announced by the U. S. Stoneware Co., 50 Church St., New York City. New features of the new pump include a double packing gland, semi-automatic gland adjustment, temperature compensation to maintain constant gland pressure, increased accessibility, standardization of all parts, dual adjustable impeller, adjustable roller bearings, lessened floor space, and increased over-all efficiency. It is further stated that all stoneware parts are ground into protecting armor rather than being cemented in. Corrosion resisting alloys are used for all metal parts subject to injury.

Another new development is that of two improved types of lubrication for valves. They are applicable to all of the stoneware valves and faucets made by this company. In one form the lubricant reservoir and pressure screw are located in the body; in the other form, in the plug.

This company also has announced "Pre-Mixt" acidproof cement, a product which is said to be entirely new in principle. The cement does not require acid painting to make it water- and acidproof. In use it is simply mixed with water and handled like ordinary portland cement. A complete set is said to be obtained in about 24 hours, with practically no expansion of the joints.

❖

Light-Sensitive Cell

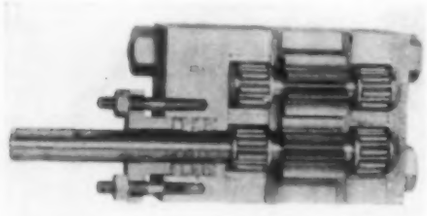
COMPLETE light-relay and light-source units of extreme simplicity have been announced by the Radiovisor Division of the Burgess Battery Co., 202 East 44th St., New York City. The relay unit, available for both a.c. and d.c. power supplies, makes use of the Burgess Radiovisor Bridge described in the October, 1931, issue of *Chem. & Met.* The units consist of an aluminum housing containing the bridge, amplifying equipment and relay. The light source comprises a housing containing a small incandescent bulb and a focusing optical system to concentrate the light beam.

❖

Nitralloy Rotary Pumps

FOR high-pressure pumping, as in feeding filter presses, Northern Pump Co., Minneapolis, Minn., has introduced a new line of Nitralloy gear pumps. This series, given the designation of XD, handles the capacity range from 1 gal. to 15 gal. per minute. Pumps are available with either Nitralloy bearings or roller bearings. Advantages claimed for the pump include high efficiency and great resistance to wear.

Section of Nitralloy Gear Pump



❖

Vertical Screw Elevator

Portable Elevator for Fine Materials

DEVELOPMENT of a portable, vertical screw elevator has been announced by Sprout, Waldron & Co., Muncy, Pa. As appears in the illustration, this consists of a 4-in. vertical screw incased in a brass pipe and arranged with a two-way discharge. The machine is self-contained and is equipped with casters for ready portability. It is dust-tight and weatherproof and is suitable for elevating fine material to equipment placed above the operating floor.

❖

Corrosion-Resistant Metal

MODIFYING the formula for "Ni-Resist," the austenitic cast iron developed by the International Nickel Co., the Lunkenheimer Co., Cincinnati, Ohio, has developed and introduced a nickel-copper-chromium cast iron of marked acid and alkali resistance. The new metal, "Causul," is being used in the manufacture of valves intended particularly for handling sulphuric acid and sodium hydroxide. Tests have shown the resistance of this material to be considerably greater than that of cast iron at all sulphuric-acid concentrations for which cast iron is suitable. The metal has shown similar improvement over cast iron in the handling of various strengths of caustic soda solution at various temperatures.

This company has also introduced what is called the "Slaset" valve, which makes use of a rotary, cylindrical, lubricated plug. This valve is licensed under Nordstrom patents and is available with both screwed and flanged ends for 150-lb. and 125-lb. service, respectively, at temperatures to 150 deg. F.

New needle valves recently announced by the company are available for regulating pressures up to 3,000 lb. at 150 deg. F. These valves are built in both Parkerized carbon steel and in Stainless steel. Sizes range from $\frac{1}{8}$ to $\frac{1}{2}$ in.

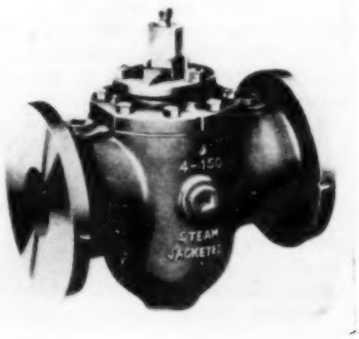
Carboy Tilter

LIKELIHOOD of carboy accidents is materially reduced, according to the Schwenk Safety Device Corp., *27* Water St., New York City, through the use of an improved carboy tilter recently put on the market by this company. In the new tilter, the carboy is elevated into the tilter by means of levers. The cradle holding the carboy box provides support on three sides and the bottom. The device is so constructed that it gives full control in pouring at all times, regardless of the quantity of liquid in the carboy.

❖

Steam-Jacketed Valves

FOR USE in conjunction with steam-jacketed piping, a new series of semi-steel valves in sizes from 2 to 4 in. inclusive has been announced by the Merco Nordstrom Valve Co., 343 Sansome St., San Francisco, Calif. As appears in the accompanying illustration,



Steam-Jacketed Lubricated Plug Cock

this valve is a lubricated plug cock with a double-walled cast body. Valve flanges have standard dimensions of the next larger standard pipe size so that no special drilling templates are required.

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Blue-Print Process

"KYANO" is the name of a new process for producing blueprints, recently announced by the C. F. Pease Co., 813 North Franklin St., Chicago, Ill. The process, designed exclusively for use with blueprint machines made by this company, is said to give an intense blue with sharp outlines and no bleeding of the blue into the white. It is said to simplify printing as it works satisfactorily over a considerable exposure range. It may be used with any coated blueprint paper, and consists in a special chemical treatment.

❖

Geared Motor

ELIMINATION of separate speed reducers is accomplished in the line of "Slo-Speed" motors developed by Sterling Electric Motors, Inc., Telegraph Road at Atlantic Blvd., Los Angeles, Calif. Integral with the motor end housing is the speed reducer case, which contains a stub-tooth gear and

pinion for speed reduction (or in some cases increase). These motors are available in standard ratios of from 3-30:1 and with output speeds obtainable ranging from 6 to 6,000 r.p.m.

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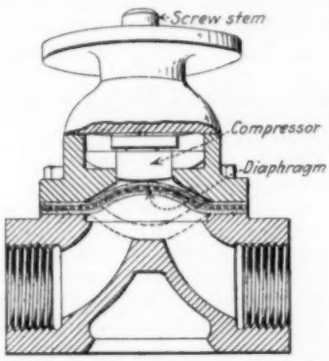


Cross-Section of Diaphragm Valve

Diaphragm Valve

METAL-TO-METAL seats have been eliminated in the new Saunders-type valve recently introduced by Hills-McCanna Co., 2349 Nelson St., Chicago, Ill. The accompanying drawing illustrates the construction. A flexible diaphragm separates the valve passages from the operating mechanism, eliminating the packing gland. In the open position, the diaphragm recedes from the seat and presents an opening the area of which is over 100 per cent of the pipe size. Screwing down on the handwheel lowers the compressor against the diaphragm and forces it tightly against the seat.

Standard practice is to build the valve body of cast iron. Valves are intended for pressures to 150 lb. and are supplied in standard sizes from 1 to 4 in. Larger valves, rubber-lined valves, and valves of special alloys are available to order.

❖

Fork Lift Truck

FOR HANDLING bulk material, such as castings, boxed glass, bags, barrels, drums, paper rolls, and so on, Elwell-Parker Electric Co., Cleveland, Ohio, has recently announced a 6,000-lb.-capacity electric lift truck, in which a pair of chisel-pointed forks replace the usual lift platform. The machine is built to use either a battery or a gas-electric unit for power production. In operation, the forks are thrust beneath the load and lifted, and the fork unit may then be tilted back 30 deg. to prevent slippage. The load may be elevated to a height of 5 ft.

❖

Printing Scale

LEGIBLE weight tickets, the printing of which does not interfere with the weighing operation, are produced, according to the Toledo Scale Co., Toledo, Ohio, by a new weight-printing device of its manufacture. This device, incorporated in the company's new Toledo "Printweigh" scales, operates instantaneously and requires practically no effort on the part of the operator. A ticket large enough to accommodate 20 weight figures is inserted in a slot in the back of the scale dial. When the weight is placed on the scale, the indicating needle comes to rest as in usual practice. Then the operator touches a button and the weight is immediately printed on the ticket. The new device avoids shock to the mechanism during the printing operation, and at the same time, because of its light weight, introduces no additional inertia. It is said that there is no possibility for ink to accumulate on the type and thus unbalance the mechanism.

❖

Glass-Lined Equipment

RANGING in capacity from 5 to 50 gal., the new Junior series of Pfaudler glass-lined steel equipment has recently been announced by the Pfaudler Co., Rochester, N. Y. This new line includes containers, mixers and storage tanks constructed of steel and lined with the same acid-resisting glass enamel used in other Pfaudler equipment. The equipment is obtainable with or without legs and fitted with special outlet valves, covers and agitators, as required.

❖

Liquid Level Controller

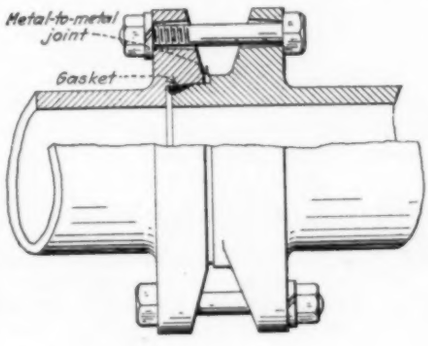
AIR-PILOT operation of a new float-type controller for liquid level has been announced by the Neilan Co., Ltd., 641 Santa Fe Ave., Los Angeles, Calif. According to the manufacturer, this instrument was developed expressly for controlling the level of liquids of high specific gravity. It is said also to be finding application in interface service where the float is required to sink in one liquid and float in another of different specific gravity. It is said that the 6-in. float used provides ample power for maintaining levels even in liquids of the highest specific gravities. Through the use of pilot control, the instrument is capable of operating remotely located control valves.

❖

Cast-Iron Pipe Joint

UNIVERSAL "Dual-Lok" is the name given to a new high-pressure joint for cast-iron pipe, recently developed by the Central Foundry Co., 420 Lexington Ave., New York City. The joint, shown in an accompanying illustration, consists of a flexible, machined, iron-to-iron joint, reinforced by a tight, flexible, non-deteriorating gasket, thus providing a double safety factor against leakage. The manufacturer recommends this joint for high-pressure work, although the company states it may be used economically for low and intermediate pressures. The joint, it will be noticed, is made integral with the pipe. The manufacturer also is prepared to supply this form of joint in a line of fittings including bends, tees, crosses, Y-branches, reducers, return bends, couplings, nipples and lug rings. Pipe is available in standard 6-ft. lengths or in shorter lengths to order.

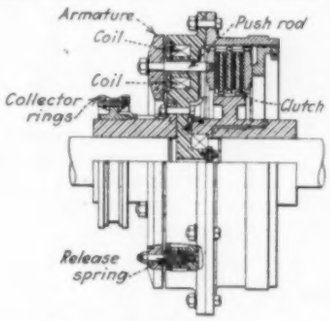
Improved Cast-Iron Pipe Joint



❖

Magnetic Disk Clutch

AN ACCOMPANYING illustration shows clearly the construction of a new multiple-disk magnetic clutch recently introduced by the Magnetic Manufacturing Co., Milwaukee, Wis. When the magnet is energized through the brushes and collector rings, pressure is transmitted to the clutch, compressing the several driving and driven rings against the friction linings. The result is said to be a smooth and even clutching action without jerk or jar to the machinery being coupled. The clutch is available in two, four and six-disk models for the transmission of from 70 to 1,157 hp. at 100 r.p.m.



Multiple-Disk Magnetic Clutch

This company has also introduced its new Type K induction separator, a high intensity machine for handling materials of low magnetic permeability. The machine is available in sizes ranging from a single-pole laboratory model to large production machine of 6 poles. The new design is suitable for the separation of many faintly magnetic materials.

❖

Propeller Type Fan

"PARAGON" is the name given to a new series of propeller-type ventilating fans recently announced by the American Propeller Co. Division of Bendix Aviation Corp., South Bend, Ind. The fans are made in two- and four-blade models for installation in walls and windows, in ducts and in cooling towers. They are also available on stands supplied with guards for portable or permanent installation. The sizes range from 12 to 72 in. and capacities from 535 to 60,000 c.f.m. of free air.

World's Largest Gas-Fired Annealing Furnace

Struthers Wells-Titusville Corp., Warren, Pa., recently placed in operation this gas-fired annealing furnace, the dimensions of which are 18x18x87 ft. It is of the car type and is used in stress-relieving of fusion-welded pressure vessels and for annealing welded alloy-steel equipment at temperatures as high as 2,150 deg. F. It is said to be capable of handling the largest and heaviest vessels the railroads can transport. The vessel entering the furnace is a 6x65 ft. high-pressure creosoting cylinder.

Acid-Proof Cement

PRODUCED both in the form of paint and cement, a new product introduced by the Sullivan Co., Memphis, Tenn., under the name of "Acitite" is being recommended by the maker for acid-proofing joints in chemical-brick tanks as well as surfaces of metal, masonry, cement, steel, wood, and stone. This product is said to be practically immune to concentrated or diluted hot or cold sulphuric, hydrochloric, nitric, acetic and lactic acids, as well as chlorine gas. Both paint and cement are applied hot, at a temperature above 250 deg. F. They set immediately on cooling.

❖

Slag Insulation

LEAD blast-furnace slag, formerly a waste product, is now being converted into an insulating wool by the Eagle-Picher Lead Co., Joplin, Mo. This wool is made into various special products including blanket insulation, pipe coverings, cement and fillers. The wool is produced by melting the slag in a blast furnace with limestone and flint. The molten mixture is then blown into a settling chamber with high-pressure steam. The resulting material in the natural state weighs 6 lb. per cubic foot. Packed under 30 lb. per square foot pressure its weight is 8 lb. per cubic foot. It is said to be verminproof and fireproof and to have a thermal conductivity of 0.27 at a mean temperature of 103 deg. F. It is useful to temperatures as high as 1,200 deg. F.

❖

Eye-Line Level Gage

ALTHOUGH it was developed particularly for use in modern power plant boilers where the water gage must necessarily be a considerable distance above the operating floor, the new eye-line water level indicator recently introduced by Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa., may also be used in reproducing level indications of other inaccessible apparatus at the operating floor. This device consists of one of the standard Yarway water columns containing a pair of displacement weights suspended from sheaves attached to the top of the column. These weights assume a relative position dependent on the water level. Entering the bottom of the column and running down to the eye-level indicator is a tube through which a corrosion-resistant chain extends from one of the displacers downward to a plunger or target exposed within a flat gage glass. Water level in the drum is then reproduced by the target in full view of the operator.

Glass-Wool Filter

AIR FILTRATION by the use of glass wool is now possible with a new product of the Owens-Illinois Glass Co., Toledo, Ohio. This product, bearing the name of "Dustop," consists of a paper container packed with a 2-in. thickness of glass wool. Large perforations in the container walls permits passage of air. The filter units may be mounted in any desired number within a metal frame. Dust collection efficiency as high as 99 per cent is claimed.

❖

Protective Coating

DEVELOPMENT of a new synthetic drying oil, known as "S.D.O.," has been announced by E. I. duPont de Nemours & Co., Wilmington, Del. The material is an amber-colored viscous liquid which may be dissolved in common paint and varnish solvents such as naphtha. After application to a surface, and after evaporation of the solvent, the material polymerizes under room conditions to a film resistant to all solvents and to most other materials except strongly oxidizing solutions.

❖

Improved Fire Extinguisher

PYRENE Mfg. Co., 560 Belmont Ave., Newark, N. J., has announced a new 1-gal. pressure-type fire extinguisher designed for ready portability and use. The extinguisher contains its liquid under an initial air pressure of 100 lb. Time of complete discharge is 55 seconds and the effective range of the stream, 30 to 40 ft. The extinguisher ordinarily is hung from the wall but is equipped with a carrying strap for use in operation.

❖

Thrustor-Operated Valve

UTILIZING its hydraulically operated "Thrustor," General Electric Co., Schenectady, N. Y., has developed a remote-controlled valve in sizes ranging from 2 to 12 in., for pressures from 125 to 600 lb. per square inch. The Thrustor is a self-contained power unit consisting of a motor-driven hydraulic cylinder which applies pressure to the valve to open or close it. The device is said to be readily adjustable for any speed of operation.

❖

Continuous CO Indicator

PORTABILITY is a feature of two models of a new continuous carbon monoxide indicator recently developed by the Mine Safety Appliances Co., Pittsburgh, Pa. The only difference between the models is that one is completely self-contained, having a storage battery within its case, while the other is designed to operate on any 6-volt storage battery or electric lighting circuit through a transformer.

The indicator consists of a canister of chemicals for removing moisture from the gas and a catalyst cell containing Hopcalite for oxidizing the CO to CO_2. Gas is drawn continuously from the sampling line through the capillary of a flowmeter, through the canister and the cell, and discharged through a small pump. Carbon monoxide, in oxidizing to carbon dioxide, raises the temperature of a series of thermocouples wired through an indicating meter. The meter is calibrated to read directly in percentage of carbon monoxide and has a scale range from 0 to 0.15 per cent CO.

❖

Self-Priming Pump

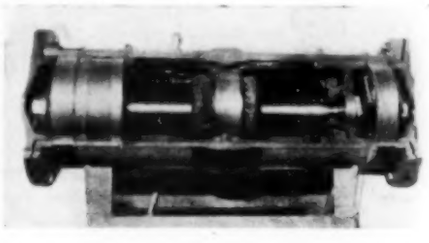
HANDLING of liquids other than those of corrosive nature is the purpose of a new line of self-priming centrifugal pumps of the direct-mounted type which has recently been introduced by the LaBour Co., 111 Sterling Ave., Elkhart, Ind. Through the use of close-coupling, wherein the pump impeller is mounted directly on the motor shaft, the new line of pumps is extremely compact, permitting economy both in space and in price.

❖

Electric Vibrating Screen

AN ACCOMPANYING VIEW shows the vibrating mechanism of the improved Mitchell electric vibrating screen manufactured by the C. W. Hunt Co. Division of Gifford-Wood Co., Hudson, N. Y. This unit consists of a special built-in motor with a shaft which extends the full length of the housing and runs on ball bearings. On each end of the shaft is a ball cage, one steel ball

Cut-Away View of Vibrator

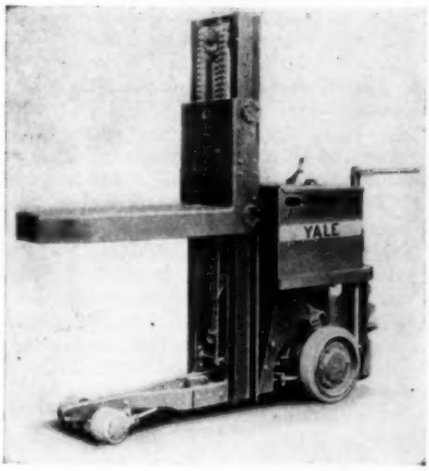


being placed in each cage. These balls are placed diametrically opposite at 180 deg. and run in hardened steel races. The eccentric loading is transmitted to the housing, so that the entire unit vibrates. This unit is attached directly to the screen frame. According to the manufacturer, practically all vibration is transmitted to the screen cloth and none to the supporting framework. It is further claimed that the intensity of vibration is practically uniform over the entire screen cloth. Screens are obtainable in lengths from 5 to 8 ft. and in 3-ft. widths.

❖

Midget Electric Truck

MEETING the need for a line of small but powerful electric trucks, the Philadelphia Division of the Yale & Towne Mfg. Co., Philadelphia, Pa., has introduced what is known as



3,000-Lb. Capacity High-Lift Truck

the KM series of low- and high-lift trucks. The line also includes platform and lift-fork trucks. Capacity ratings of 3,000 and 4,000 lb. are available.

❖

Improved Cork Board

COLD-ROOM insulation may be handled more efficiently, according to the Armstrong Cork & Insulation Co., Lancaster, Pa., with its new "Superservice Corkboard," a recent development of this company. The board is said to have 10 per cent greater insulating efficiency than standard corkboard and to be completely resistant to air and moisture infiltration. These improvements are accomplished by applying a continuous seal to each board at the factory. The sealing compound is an asphaltic material said to insure permanent insulating efficiency.

❖

Variable-Speed Transmission

COMPLETING its line of inclosed, variable-speed transmissions, Reeves Pulley Co., Columbus, Ind., has announced a new vertical, inclosed transmission. The new unit incorporates the standard internal operating parts of the Reeves transmission and is equipped with a dustproof, oil-tight, cast-iron case which provides complete protection for the mechanism. The drive is equipped for pressure lubrication which can be accomplished completely without removal of the case cover. It may be equipped with electric-remote, electric-automatic and mechanical-automatic controls. The design is available in ten sizes covering speed ratios of from 2:1 to 8:1 inclusive.

Manufacturers' Latest Publications

Agitators. Patterson Foundry & Machine Co., East Liverpool, Ohio—Folder describing the "Typhoon" portable mixing unit for outboard attachment to process vessels.

Air Conditioning. Policyholders' Service Bureau, Metropolitan Life Insurance Co., 1 Madison Ave., New York City—Industrial Health Series No. 5—20 pages on air conditions and the comfort of workers.

Bearings. Tyson Roller Bearing Corp., Massillon, Ohio.—Second Edition, "Engineering Manual"—Loose-leaf book containing essential engineering data on the application of this company's cageless, tapered roller bearings for all anti-friction purposes.

Burners. Central Scientific Co., 460 East Ohio St., Chicago, Ill.—Folder describing a new line of gas burners for laboratory use.

Burners. Lee B. Mettler Co., 406 S. Main St., Los Angeles, Calif.—Folder briefly describing this company's new automatic, "Series C Triple Control" conversion unit for gas burning.

Burners. Schutte & Koerting Co., Philadelphia, Pa.—Bulletin 16-G—8 pages on this company's oil and gas burners.

Chemicals. Monsanto Chemical Works, St. Louis, Mo.—Annual Report showing financial and technical achievements of Monsanto during 1931.

Conveyors. Traylor Vibrator Co., 1400 Delgany St., Denver, Colo.—Folders describing pictorially this company's tubular and screening conveyors.

Cork. L. Mundet & Son, Inc., 461 Eighth Ave., New York City.—19-page catalog on cork products made by this company for use in refrigeration, soundproofing, heat insulation and vibration deadening.

Disintegration. The Jeffrey Mfg. Co., Columbus, Ohio—Folder briefly describing the range of pulverizing and crushing machinery made by this company.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-855B, Super-synchronous motors; GEA-1123A, Outdoor switching equipment; GEA-1262B, Thrustors; GEA-1572A, 16-pages on electric steam generators.

Electrical Equipment. Wagner Electric Corp., 6400 Plymouth Ave., St. Louis, Mo.—Bulletin 174 — 22-page booklet describing seven types of squirrel-cage motor, with application and engineering information.

Engineering. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—40-page book describing engineering achievements of the Westinghouse Electric & Mfg. Co. during 1931.

Equipment. U. S. Bottlers Machinery Co., 4015 N. Rockwell St., Chicago, Ill.—59-page catalog of filling machinery and equipment, describing the principles and applications of a wide variety of machinery made by this company.

Fabrication. Edge Moor Iron Co., Edge Moor, Del.—Booklet 71—8 pages describing services in the fabrication of special equipment offered by this company.

Fans. Century Electric Co., 1806 Pine St., St. Louis, Mo.—Bulletin 42—12 pages on portable, ceiling type and ventilating electric fans made by this company.

Gas Masks. E. D. Bullard Co., 224 W. Huron St., Chicago, Ill.—15 pages on gas masks manufactured by this company, listing in tabular form the properties of, and required protection for, a considerable number of industrial gases.

Gas Producers. Semet-Solvay Engineering Corp., 40 Rector St., New York City—Bulletin 45—12-page booklet completely describing the construction and operation of the producer-gas generators made by this company.

Heaters. The Trane Co., La Crosse, Wis.—Catalogs describing heating equipment made by this company, including booklets on a system of unit heating, unit heaters, a temperature control valve, miscellaneous heating specialties, performance data on extended-surface heaters. Also booklets on radiators, humidifiers and combination radiator-humidifier units for factories, offices, public buildings and homes. Also bulletin on centrifugal pumps made by this company.

Humidification. The Industrial Dryer Corp., Stamford, Conn.—Bulletin describing the Harris humidifier made by this company.

Instruments. Esterline-Angus Co., Indianapolis, Ind.—Bulletin 828—Folder describing the organization and methods used by this company in the production of instruments.

Instruments. The Hays Corp., Michigan City, Ind.—Catalog PGA-32—20 pages on pointer gages for the measurement of draft, pressure, differentials and temperature.

Lamps. Mine Safety Appliances Co., Pittsburgh, Pa.—Bulletin 96—4 pages on portable electric lamps of U. S. Bureau of Mines approved construction.

Line Pipe. Republic Steel Corp., Youngstown, Ohio—36 pages on the manufacture of this company's newly developed electric-welded line pipe and casing. Includes descriptive material and engineering data. Requests for this book must be made on business letterhead.

Materials Handling. The Jeffrey Mfg. Co., Columbus, Ohio—Catalog 535—46 pages on this company's belt conveyors, with the descriptive information and engineering data.

Optical Parts. Bausch & Lomb Optical Co., Rochester, N. Y.—46-page book on lenses, prisms, reflectors and other special optical items.

Power Transmission. Morse Chain Co., Ithaca, N. Y.—Bulletin C-66—12 pages on the Morse "Pulimore" clutch sold by this company.

Pulverizers. Raymond Bros. Impact Pulverizer Co., 1602 N. Branch St., Chicago, Ill.—Booklet describing installations of this company's pulverizing, air separating, and dust-collecting equipment during 1931.

Pumps. Taber Pump Co., 288 Elm. St., Buffalo, N. Y.—Folder describing this company's double-suction centrifugal pumps for capacities to 1,500 g.p.m.

Refractories—General Refractories Co., 106 S. 16th St., Philadelphia, Pa.—12-page reprint of an article entitled "New Developments in Unburned Magnesite Brick for the Metallurgical Industry."

Screens. Orville Simpson Co., 1230 Knowlton St., Cincinnati, Ohio—Folder describing the application of this company's Rotex screeners in the manufacture of a number of typical products.

Steam Generation. Whiting Corp., Harvey, Ill.—Bulletin 101—16 pages on the Whiting stoker made by this company.

Steam Tables. The Superheater Co., 60 E. 42d St., New York City—Second printing of this company's pocket-sized steam tables, prepared by Prof. J. H. Keenan from his "Steam Tables and Mollier Diagram." Gives information on superheating and includes an improved Mollier diagram.

Structural Panels. Truscon Steel Co., Youngstown, Ohio—20-page book describing this company's recently developed line of semi-rigid and rigid structural and insulating materials in board form, consisting of metal facings, cemented to insulating core material and supplied in the form of panels.

Valves. Reading-Pratt & Cady Co., Bridgeport, Conn.—Folder describing this company's new lubricated gate valve.

Ventilators. Allen Corp., Detroit, Mich.—Folder describing turbine-type ventilators made by this company.

Waste Treatment. Hardinge Co., York, Pa.—3-page folder briefly describing sanitation and trade-waste equipment including clarifiers, digesters, aerators, coagulant mixers and dryers made by this company.

Welding. Linde Air Products Co., 205 E. 42d St., New York City—two-reel motion picture showing the technique of the recently developed Lindeweld process, applied to the construction of a 20-in natural gas line. Film will be loaned gratis, in 16-mm. and 35-mm. widths, for showing to technical and industrial groups.

Welding. Metal & Thermit Corp., 120 Broadway, New York City—10-page booklet describing the properties and uses of Murex flux-coated welding rods recently placed on the market by this company. Electrodes available include those for welding mild steel, manganese steel and Stainless steels.

Wire Rope. Hazard Wire Rope Co., Wilkes-Barre, Pa.—Booklet entitled "12 Reasons Why You Save Money With Lay-Set Preformed Wire Rope."

NEWS *of the* INDUSTRY

Chilean Government Will Accept Cosach Plans

AGITATION for the dissolution of Cosach and the setting up of a new control for the nitrate of soda industry in Chile, which has been rife practically since Cosach was formed, appears to have settled in favor of the present plan. Press dispatches from Santiago state that an agreement was reached on March 8, whereby the Chilean government agreed to the proposals made by Medley G. B. Whelpley, representing Cosach. According to these reports the government will assist in improving conditions in the nitrate industry, with the Finance Minister quoted as saying: "In the present world situation of nitrogen fertilizers it has been deemed more prudent to maintain the present structure of the Cosach company."

The U. S. vice-consul at Antofagasta, in a recent report on the nitrate industry in 1931, stated that the year witnessed the opening of the second Guggenheim process plant in Chile and the definite closing of over 100 small plants using the "Shanks" process.

When the Cosach was formed it was thought that the Oficina Chacabuco would be the only one of the Shanks type to continue operations. This is the only one operating in the Antofagasta pampa, which is practically all cleared of nitrate. However, due to the serious unemployment situation of the Iquique district, two Shanks plants were opened there. The Oficina Condor, near Iquique, is the only plant outside of the Cosach which has continued operation during the year. It is controlled by French capital. This plant can operate at the present low prices only because it is working nitrate ores of over 25 per cent. The two Guggenheim plants in operation are able to work ores as low as 9 per cent of nitrate content. The fourth Shanks plant which continued operation under the Cosach was near Taltal.

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Chemical Engineers Plan Unemployment Relief

A MASS meeting sponsored by the Committee on Unemployment and relief for Chemists and Chemical Engineers in Greater New York was held March 4 at the Engineering Societies Building. The meeting was presided over by George C. Lewis. Edward R. Weidlein, director of Mellon Institute of Industrial Research, spoke on the chemist as a creator; we need him now. Raymond V. Houston, executive director, Emergency Work Relief Bureau of New York City, spoke on the unemployment situation in general—what can be expected on the relief means now available. J. P. H. Perry told the meeting about the activities of the four founder engineering societies. Prof. D. D. Jackson, of the chemical engineering department of Columbia University, gave some interesting data on unemployment and relief for chemists and chemical engineers in the metropolitan district. Dr. Charles H. Herty, past president of the American Chemical Society, gave his opinions on what the chemists and chemical engineers should do.

The meeting adopted a resolution offered by Prof. Jackson which advocated that all chemical and chemical engineering societies in the metropolitan district take action by: (1) appropriating as much as possible from present funds to keep the present work going and make possible an effective central organization; (2) appointing a representative to the central committee to help organize a campaign for funds and to assist in planning and carrying forward constructive work in finding jobs for chemists and chemical engineers; (3) appointing a committee to work among its own members to develop financial and moral support for the work of the central committee, to the end that each member of the profession may realize the importance to himself of aiding in every way possible in placing unemployed chemists and chemical engineers.

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Industrial Conference on Air Conditioning

A PRELIMINARY announcement concerning the third industrial conference to be held at Case School of Applied Science, Cleveland, Ohio, is made by Prof. G. L. Tuve, general chairman. The subject of the three-day meeting, sponsored jointly by Case School and the Cleveland Engineering Society, is "air-conditioning," the sessions of which will be held March 17-19.

The purpose of the conference is two-fold. Some of the sessions will pertain to the conditioning of air for human comfort. The remainder of the conference will deal with industrial processes requiring controlled air conditions.

New Patent Office Will Open April 11

CELEBRATION of the final step in moving the U. S. Patent Office into its new quarters in the new Commerce Building, Washington, D. C., will take place on April 11. Plans for the occasion contemplate three sessions during the day, closing with a dinner at the Hotel Willard.

The celebration is in the hands of a national committee with H. H. Dyke as chairman. The committee represents a nation-wide array of institutes, associations, and organizations.

The morning session of the celebration will be held in the auditorium of the new Commerce Building. In the afternoon a reception is to be held in the new Patent Office, at which Commissioner Thomas E. Robertson and his force will be hosts to the official delegates and to the general public in an inspection of the quarters, conveniences, and modern equipment provided by the new building.

In connection with the occasion a special invitation to attend has been extended to the 13 most notable American inventors and scientists now alive. They include Prof. Elihu Thomson, Dr. Willis R. Whitney, Dr. William D. Coolidge, Dr. Irving Langmuir, Prof. Michael I. Pupin, Dr. Leo H. Baekeland, Nikola Tesla, Senator Guglielmo Marconi, Dr. Charles L. Reese, Dr. Frank B. Jewett, General J. J. Carty, and Charles F. Kettering.

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New Soya Bean Oil Process Developed in Manchuria

THE South Manchurian Railway, under Japanese control, is looking for capital to assist it in exploiting the Manchurian soya bean industry, according to reports received from the U. S. Consulate General at Mukden.

Oil will be extracted from the beans, according to tentative plans of the railway company, by the use of alcohol instead of benzine, and the cake produced in the course of extraction will be used for making yeast and feed for poultry. The company is said to have a patent on the new method of extraction.

During January, shipments of beans from Vladivostok and Dairen totaled 174,000 metric tons, as compared with 233,000 metric tons sent out during the same period last year.

Oil Symposium Arranged For A.C.S. Meeting

AN ATTENDANCE of more than 1,000 men interested in chemical and related activities is expected at New Orleans, March 28 to April 1, for the eighty-third meeting of the American Chemical Society.

A symposium of oil experts under the chairmanship of Dr. R. T. Haslam, vice-president of the Standard Oil Development Co., will feature the convention. Among those who will deliver addresses on the general theme of "Chemical Engineering Processes in the Oil Industry" are: Dr. Merrell R. Fenske, Pennsylvania State College; Alfred Fisher, Jacque C. Morrell, and Gustav Egloff, Universal Oil Products Co., Chicago; Dr. Warren K. Lewis, Massachusetts Institute of Technology; Charles Allen Thomas and William H. Carmody, Thomas & Hochwalt Laboratories, Inc., Dayton, Ohio; J. B. Maxwell, Standard Oil Development Co., New York City; S. N. Obryadchikoff and W. A. Peters, Jr., E. B. Badger & Sons Co., New York City.

The opening event is a meeting of the council on March 28, President Redman presiding. On Monday afternoon there will be a general meeting, at which a group of special papers will be presented by men prominent in various fields. H. A. Gardner, of Washington, D. C., will discuss "Tung Oil and Its Production in the South." Thomas Midgley, Jr., of the General Motors research staff, will speak on "Fluorination." Technical sessions will be held on Tuesday and Wednesday.

The division of chemical education, in addition to the joint meeting with the division of medicinal chemistry and the division of biological chemistry, has scheduled three half-day sessions, one being the meeting of the senate and standing committees.

Other professional divisions of the society which have arranged programs for Tuesday and Wednesday and their chairmen include:

Cellulose, Fred Olsen, director of research, Western Cartridge Co., East Alton, Ill.; History of Chemistry, Prof. Lyman C. Newell, Boston University; Organic, Prof. Homer B. Adkins, University of Wisconsin; Paint and Varnish, Harley A. Nelson, research chemist, New Jersey Zinc Co., Palmerton, Pa.; Sugar, W. L. Howell, chief chemist, U. S. Treasury Department, New Orleans, La.; Water, Sewage, and Sanitation, A. S. Behrman, chief chemist, International Filter Co., Chicago, Ill.

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Casale Perfects Synthetic Ammonia Process

A REPORT from the U. S. Trade Commissioner at Rome states that the Casale Co. is perfecting its synthetic ammonia process to further reduce production costs. At the Terni plant of the research company a process for purifying the nitrogen-hydrogen gas mixture has been worked out. The first industrial installation of this process began operations at the Ostend plant of the Belgian licensees about the middle of October, 1931, with, it is stated, highly satisfactory results. According to the Casale Co., the units at Ostend have a rated capacity of 8 tons of ammonia. Since the introduction of the purifying system, it is said that they have been giving steadily an average of 17 tons of anhydrous ammonia per day during the two months the process has been under operation. The Casale Co. states it has made arrangements for licensing rights for this process.

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Dr. Herty Will Establish Paper Plant in Georgia

DR. CHARLES H. HERTY having successfully demonstrated on an experimental scale the feasibility of a pulp and paper project utilizing as raw material the several species of pine trees that grow in Atlantic Gulf states, has acquired the support necessary for the construction and operation of a semi-commercial plant at Savannah, Ga.

The plant has been made possible by the contribution of $50,000 for equipment from the Chemical Foundation, Inc., an appropriation of $40,000 from the Georgia Legislature, and by the assistance of the Industrial Committee of Savannah and of the machinery manufacturers.

The staff of the Division of Pulp and Paper Research, Georgia State Department of Forestry and Geological Development, includes, in addition to Dr. Herty, who is in charge, G. C. McNaughton, in charge of the plant; W. F. Allen, chemist in charge of the laboratory. J. B. Osborne, Jr., will be connected with the laboratory and Bruce Suttle will assist Mr. McNaughton. George W. Lindsay will act as paper machine mechanic and S. W. Hendrix will be the plant mechanic, with Spencer Noble assisting.

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I.C.I. Enters European Dye Agreement

ADVICES received from Commercial Attaché William L. Cooper at London give the information that Imperial Chemical Industries, Ltd., had confirmed a report that that company had concluded an agreement with Continental dye manufacturers affecting the European dye market.

C. C. Concannon, chief of the chemical division of the Bureau of Foreign and Domestic Commerce, said it was believed the agreement related to allocation of markets excluding the United States. It is thought, he said that the arrangement does not include price control or interchange of technical information. German dye prices in England have increased 10 per cent since the conclusion of the agreement and an additional increase in prices by British dye makers is expected. A few weeks ago it was announced that the Italian dye industry had joined the European cartel.

Gas Association Will Meet in Birmingham

WHAT promises to be one of the outstanding features of the ninth annual conference of the distribution committee, technical section, American Gas Association, which will open a three-day session in Birmingham, Ala., on April 6, will be ample opportunity for a thorough inspection of the manufacture of different types of cast iron pipe, an industry for which the Alabama city is noted.

Among the principal topics to be discussed at the conference will be those of change-overs from manufactured to natural gas; service to customers; employee training; pipe joints, pipe coatings and corrosion; unaccounted-for gas; corrosion research as carried on at the U. S. Bureau of Standards, under the auspices of the American Gas Association corrosion committee and economics of moving locked and inactive meters.

The open forum will be continued this year and it is expected that many engineers who have local problems will take advantage of this opportunity of bringing them before the Conference. All business sessions of the conference will take place at the Tutwiler Hotel.

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Chemical Workers Health Hazards Studied

THE New York State Department of Labor maintains a Division of Industrial Hygiene whose function is to study the sickness and accident problems of industry and to evolve preventive measures. With a staff of physicians and chemists and specially trained inspectors, this division is prepared not only to give scientifically correct information to employers but also to consider individual problems of workers exposed to disease or injury in their occupations, and to give personal advice in such cases.

Under the direction of J. D. Hackett, this division has made a special study of the health hazards of workers whose occupations require the use of chemicals, and has issued a series of industrial hygiene leaflets.

It is the aim of these leaflets to acquaint workers, employers, physicians, and the public in general with the fact that occupational poisons do exist, to give simple rules for recognizing them, and to suggest some of the improved methods of prevention.

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Reilly Chemical Acquires Coal-Tar Company

THE Reilly Chemical Co., Inc., producer of coal-tar and carbon products at Indianapolis, Ind., has purchased the plants and assets of the International Combustion Tar & Chemical Corp. The latter corporation has been in the hands of a receiver for about two years. It operated plants engaged in the manufacture of coal-tar products at Chicago, Newark, and Chattanooga.

NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

UPON the products of the chemical process industries will fall approximately one-fifth of the burden imposed by the sales tax of 2½ per cent, recommended by the House Ways and Means Committee as the most expedient method of raising the revenue necessary to balance the government's budget. It is estimated that the process industries will have to pay $135,000,000 of the $600,000,000 total. Assuming that the f.o.b. factory value of the process industries' production has shrunk from $11,500,000,000 in 1929 to $9,000,000,000, and deducting one-third that, as constituting the raw materials of other industries, is not taxable directly, there remain products to the value of $6,000,000,000 that are liable for the tax, subject to specific exemption of fertilizers, sugar, and salt. As 70 per cent of sugar's $600,000,000 total is eliminated in industrial consumption, only fertilizers and salt, which at the outside probably account for $250,000,000, is deductible from the $6,000,000,000 total on which the process industries' tax liability is estimated. Export sales, which are exempt from tax, have been disregarded in this approximation of the tax base. A special tax of 4c. a gallon on lubricating oils is expected to produce approximately $25,000,000, and other taxes on wort, malt preparations, and grape concentrate may add $50,000,000.

AS FINALLY introduced, Senator Bingham's bill for regulating the sale of poisonous volatile substances is much more limited in scope and character than the measure originally drafted by Prof. Yandell Henderson, of Yale. In its revised form, it is essentially a labeling bill applicable to household containers of a specified list of products as follows: aniline oil, benzol, carbon disulphide, cyanogen and its volatile compounds, formaldehyde, methanol, ethylene oxide, nicotine, nitrobenzol, sulphur dioxide, and all halogen compounds of hydrocarbons in a concentration of 5 per cent or more.

Although the bill is much less objectionable than the original draft, which would have applied to all chemicals of a volatile type having toxic characteristics, whether or not used in the household, further opposition can be expected. With respect to some of the groups of commodities named, the labeling requirements would constitute a needless restriction. There is also objection to authorizing an administrative official to make additions to this list, although the provision limiting the authority of the Secretary of Agriculture in this respect to the recommendation of the Surgeon General is regarded with approbation.

There is much sentiment in the chemical industry, however, against a blanket system of regulation subject to indefinite extension. While it is felt that various compounds should, perhaps, be labeled, there are many who believe that this can be accomplished by self-regulation, the principle to which the Bingham bill is opposed.

EXPERIENCE with the use of completely denatured alcohol formula No. 5 demonstrates that the Bureau of Industrial Alcohol has not yet discovered a satisfactory substitute for CD1, in which methanol was the principal agent. Popular protest against the obnoxious odor is a persuasive argument that alcotate and possibly aldehol must be discarded in any anti-freeze formula, if ethyl alcohol is still to be used for this purpose.

Commissioner Doran will not voluntarily revert to the use of methanol in the c.d. formula which made him the butt of tirades against poison liquor and legalized murder, although the wood alcohol manufacturers would like to believe that he leaned in this direction in authorizing this month the optional use of 5 per cent of methanol as a substitute for calol ethatate in denaturing ethyl acetate.

Since methanol was eliminated from the c.d. formula in January, 1931, the demand for the specially denatured materials, in which methanol is still employed as a denaturing agent, has increased considerably. Proprietary solvents also have been in great demand. This is regarded as convincing evidence that methanol is the most satisfactory denaturant and there may be no alternative to its restoration in the c.d. formula if Commissioner Doran's technical staff cannot devise another that will effectively prevent diversion of ethyl alcohol as a beverage without destroying its usefulness for the purposes intended. The demand that this vexing problem be dealt with in time to prevent interference with the distribution next autumn of the anti-freeze supply is becoming insistent.

THE Bureau of Industrial Alcohol is revising its specifications for the denaturing grade of methanol required in specially denatured formulas. Instead of requiring that wood alcohol shall measure up to a certain standard of purity, the new specifications will require a certain percentage of impurities. This reverse action was dictated by the fact that wood alcohol is reaching such a high degree of refinement that, lacking pronounced odor and color, it is losing its effectiveness as a denaturant.

In response to the plea of trade association executives, attorneys, and business men, a subcommittee of the Senate Judiciary Committee now is attempting to frame a bill to give legal status to agreements reached under the Federal Trade Commission's conference procedure. The committee bill will be carefully framed to avoid giving outright immunity from the Sherman act. There will either be provision that (1) trade practice rules shall be only *prima facie* legal or (2) that the Department of Justice may request the Commission at any time to revoke conference agreements that, in its judgment, are in restraint of trade. This is practical assurance, at least, that industrial groups attempting, in good faith, to work out a code with the cooperation of the Commission will not be harrassed by threat of prosecution. There will be no provision similar to that in the Nye bill, now before the subcommittee, whereby the majority of an industry could bind a non-participating minority to observe rules which condemn practices that may be bad business but have not been defined by the courts as unfair methods of competition. Price discrimination and selling at less than cost except in special circumstances were so defined in the Nye bill, but, apprehensive that condemnation of such practices would be construed as government sanction of price-fixing, the subcommittee will drop these items.

ON the date that this report was written neither the Senate nor the House committee had completed framing legislation for disposition of Muscle Shoals. The only novel feature of the bill that, according to Rep. McSwain, will be presented to the House in April, is provision for turning the property over for private operation in the event that a lessee should present himself after government operation has commenced. As provided in the bill vetoed by President Hoover last session, government operation would be a mandatory alternative in the event of failure to find a lessee in the first instance. The Senate committee probably will report the original Norris bill, although Senator Norris has announced that he may present an amendment on the floor that would remove the limit of 8 per cent on the profit from fertilizer production. Senator Norris will insist upon fertilizer production as the prime condition for leasing, but provision will be made for the erection of power transmission lines.

A report from our trade commissioner at Berlin states that soda-ash production in Germany is reported to have declined in the past two years to around 600,000 metric tons annually, indicative of the depression of its consuming industries. However, caustic soda production, at 110,000 to 120,000 metric tons annually, appears to have held its own. German production of caustic potash is estimated at around 50,000 metric tons annually.

British Industries Encouraged by Recent Tariff Changes

Production and Sale of Chemicals Gained in Last Two Months

From Our London Correspondent

THE change-over of Great Britain to a tariff-conscious country has proceeded so smoothly that it is easy to draw false conclusions and to lull one's self into a sense of security. Industrialists and particularly leaders in the chemical industry have shown a praiseworthy appreciation of the benefits and the difficulties which devolve upon them. It is already clear that a tariff designed mainly for revenue purposes, and necessarily in many cases of uncertain duration, is not likely to offer sufficient inducement for the wholesale establishment of factories or the transfer of processes and industries from countries which have hitherto had Great Britain available as a free market for their exportable surplus. This applies particularly to the chemical industry, where ample facilities exist for successful cooperation with existing organizations in preference to the more costly expedient of independent manufacture and marketing; as regards reciprocal trading, the present position of industry in European countries will not permit of any far-reaching adjustment, by means of a tariff, of the balance of trade, but may intensify competition in neutral markets. There is, however, considerable, inducement for American manufacturers to consider the possibilities by market surveys here and in the British dominions in order to take advantage of reciprocal preferential arrangements likely to result from the Empire Conference at Ottawa in July.

Sir Harry McGowan, chairman of Imperial Chemical Industries, Ltd., has expressed confidence in the immediate future, partly based upon improved results during the last two months in sales and production, and he rightly described the heavy chemical industries as an essential barometer of general trade. The improvement may partly be accounted for by the replenishment of stocks in anticipation of a rise in the price level, which even if controlled, probably is inevitable; in fact, the absence of the fear of inflation and the philosophical way in which recent difficulties have been overcome, has not only stimulated confidence here, but is likely to induce that confidence in other countries which is so necessary for a real revival in trade.

WERE it not for these factors, the present outlook would be far more serious; the basic industries such as iron and steel, shipbuilding, coal, cotton and wool, probably are at their lowest ebb, and yet the better financial outlook, the feeling that there is at last a definite change, and other stimuli of which the British Industries Fair is a good example, seem to show clearly that better times are in store for British chemical industries, and that, generally speaking, there is today an opportunity for the foreign investor which may never occur again. This exceptional and perhaps unique state of affairs justifies a departure from the normal character of these notes and, moreover, the general situation has so overshadowed other news that perhaps no excuse is needed.

The nitrogen situation continues to give anxiety, in spite of the arrangement made between the German and French nitrogen syndicates in regard to the purchase of German nitrate of soda to the extent of 150,000 tons, and to replace Chilean nitrate. Some of the French requirements will also be covered from the United States, and the lower price level is at last overcoming the inertia of the consumer. Improved marketing and information service have contributed to this in no small measure, and it is regarded as quite possible that during the next two years the industry as a whole will again be on a paying basis. This cannot be said for the rayon industry, in which profits at present are practically non-existent except for specialized manufacture, the largest producers apparently having decided that the industry as a whole may be best served by the elimination of all weak producers and redundant factories.

ONE effect of the depreciation of sterling and of the import duty has been to stimulate home production of cellophane or transparent paper, and Courtaulds, Ltd., who entered this field some months ago, have doubled their plant. The writer recently returned from a Continental trip, and there seems no doubt that mutual tariff and currency restrictions have played havoc with the European chemical industry, factories planned for production in excess of home requirements invariably operating at a loss or on an uneconomic basis. After all, it is not logical to supply customers who have not paid for the goods last delivered, and it would not be surprising to find a number of plants closed and manufacture concentrated in smaller and more economic units. For this reason, England is regarded as being favorably situated, and is now facetiously called "NewPoundland."

Good progress is reported regarding the exploitation of the Dead Sea concession, which it will be remembered led to the formation of Palestine Potash, Ltd., operating the concession granted to Major Tulloch and Mr. Novomeysky. C. Tennant Sons & Co., Ltd., of London, whose chairman is Lord Glenconner, are heavily interested in this company, and the intention is to develop on the technical and production side sufficiently to enable a public company to be formed for full and economic exploitation. Bromine is already being produced and, of course, the evaporation of the various salts and their harvesting has been going on for some time. The concentrated solutions are pumped from a depth of about 180 ft. in a 30-in. diameter pipe line, and although hot, the valley of the Jordan appears to be very healthy, with good air and a continual and refreshing wind. It is reported that potassium chloride is now also being produced on a commercial scale, and of course the ultimate development will include the construction of a railway line to the cost as soon as world conditions become favorable.

The formation of a food group by the Society of Chemical Industry is an event of considerable importance, having regard to recent developments and the growth of the industry in this country and the British Empire. The first chairman is Dr. L. H. Lampitt, chief chemist of J. Lyons & Co., Ltd., who from small beginnings have built up a wonderful research organization employing over 100 highly trained chemists and engineers. It has long been obvious both to the public and to the board of directors of Messrs. Lyons that all this has been a good investment.

The Institution of Chemical Engineers has suffered another grievous loss in the untimely death at an early age of Sir Arthur Duckham, its first president. Duckham was of a very lovable disposition and an untiring worker, who was really on the threshold of a great career, although the records standing to his credit were no mean achievement. He was a pioneer in the gas industry and did sterling service during the War and during the reconstruction period, and he will be sadly missed both here and among his friends in America.

USE of trichlorethylene in the dry cleaning industry has been increased rapidly during the last few months, owing to the introduction of a new type of machine for the individual cleaning of garments in a few minutes, as distinct from the more normal practice of putting 30 or 40 of them in a rotary washing machine for over an hour. The apparatus combines a small rotary washer with a store tank for the solvent above it, and a still below, from which clean solvent is returned to the storage tank. These machines together with a hydro extractor and drying plant, attract much attention in retail shops, which report very good business. Other machines are using mixtures of carbon tetrachloride and benzene, and, where large enough, are combined with a solvent recovery plant. There seems little doubt that the trichlorethylene individual method will be considerably extended, and it is credibly reported that already one-half of the "tri" sold in this country is used for that purpose and for other degreasing operations.

Fuel Technology and Economics Occupy German Industry

International Trade Restrictions Grow Acute to Chemical Manufacturers

From Our Berlin Correspondent

ADDED light on the critical economic position of Germany has been offered by recent newspaper accounts of large bank mergers, with reduction in capitalization. According to later industrial reports, the industrial production reached only 44.8 per cent of capacity during 1931. The monthly average value of production was only 3,500,000 Marks in 1931, against 7,000,000 in 1928. Almost one-third of all employees are idle; the national income has sunk from 76 billion Marks in 1929 to about 50 billion in 1931. Construction work, amounting to nine billion in 1930 and four billion in 1931, is expected to recede to two billion in 1932. In the chemical market the difficulties are still increasing and the impression is gaining that the prevailing economic system cannot be maintained much longer. Exports, on which industrial nations are dependent for existence, cannot now be increased in the face of constantly rising trade barriers.

The question of a motor fuels monopoly continues to retain public attention. Negotiations between the I.G. and Benzol Union have thus far proved fruitless. On the other hand, the problem of producing alcohol from wood is again gaining significance. According to Bergius, large quantities of German lumber, especially low-grade, could be consumed in producing the 5 per cent alcohol constituent of the proposed standard motor fuel, discussed in this letter last month. In addition to the Bergius process, another one under the name of Scholler-Tornesch, for the production of sugar and alcohol from wood, has reached the commercial stage, as discussed below. It needs to be pointed out, however, that the difficulties surrounding a standard motor fuel are complex and considerable, especially the loss of 88,000,000 Marks in customs.

THE Scholler-Tornesch process, in which weak acid converts cellulose into sugar through percolation, produces 50 kg. of sugar from 100 kg. of sawdust, 40 kg. of the product being fermentable. If, through the use of this process, only 5,000,000 tons of the previously worthless waste wood is treated, 2,000,000 tons of sugar can be produced. The total production of the entire German beet sugar industry is only 1,900,000 tons. The wood sugar would not compete with the edible variety, but rather would be used in animal feed and for the production of enough alcohol to make the country independent of foreign motor fuels. A valuable byproduct is lignin, a useful fuel, of which about 30 kg. remains after the treatment of 100 kg. of sawdust.

The question of coal as a fertilizer has again turned up in the important experiments of Prof. Lieske, of the Kaiser Wilhelm Institut für Kohlenforschung. He found that the addition of certain lignites caused an increase in grain and vegetable crops when mixed into the soil. The question, which components of the coal are the beneficial agents, has been answered by the discovery that the coal itself is inactive, but includes huminic acid, or its compounds, which enter into reaction in the soil. A promising feature of the practical application of the experiment is the use of coal in a prepared rather than a raw state for fertilization. For coal contains inhibiting as well as beneficial compounds; for example, its reducing and acidifying constituents. But their deleterious effects can be prevented by a preliminary saturation with alkali, preferably ammonia, the product then containing about 4 per cent of nitrogen. The experimental results have demonstrated that coal fertilization probably will play a considerable part in future agriculture.

The North European Oil Corp., which owns a large prospecting territory in lower Saxony, has abandoned its drilling operations because of the uncertain market. After selling some of its prospecting rights to the Royal Dutch group in May, 1931, for $900,000, it reported to be in a position to develop a systematic drilling program, but the two drillings that have been made have proved unsuccessful. The abandonment of the activities of the North European thus appears very much in the light of a speculation.

SINCE the stabilization of currency in 1931, petroleum imports into Germany have declined for the first time but not to the extent that would be expected from the depression. The sharp decline in petroleum prices is evident in the considerably lower value of the imports. It is further remarkable that only Russia has been able to increase its share in the imports considerably. Russian gasoline imports into Germany grew from 177,000 to 281,000 tons from 1930 to 1931, and its share in the total imports from 12.4 to 20.9 per cent.

In his research on the development of gasoline synthesis from water gas, Franz Fischer has found that the activity of cobalt catalyzers can be greatly enhanced to the end that the yield in liquid hydrocarbon per cubic meter of gaseous mixture is raised from 100 c.cm. to 153 c.cm., corresponding to 71 per cent conversion. These new cobalt catalyzers can be used for a duration of over two months. The generation is effected by extraction of the paraffine that collects in the catalytic mass.

A new sodium light source has been developed by the Osramkonzern, Berlin. The beam is about 20 times as strong as that of a good sodium Bunsen burner. It is particularly suited for polarimetric analyses, especially in the sugar industry. Various other uses for it, as in inspection of fine machinery surfaces, are foreseen.

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Senate Receives Norris Muscle Shoals Bill

THE Senate has received a favorable report from its Committee on Agriculture and Forestry on the resolution to provide for government operation of the Muscle Shoals power project in Alabama. The resolution, which was reported from the committee without amendment by its author, Senator Norris, of Nebraska, creates a corporation to be known as the "Muscle Shoals Corporation of the United States," with a board of three directors to be appointed by the President.

Under the resolution the board is authorized to operate the existing plants for experimental purposes, to construct new experimental plants for the manufacture of fertilizer, to contract with commercial producers for the production of fertilizer as may be needed in the government's program, to arrange with farmers for large-scale practical use of the new forms of fertilizers, and to manufacture fixed nitrogen.

Upon the requisition of the Secretary of War or Navy the board is to manufacture and sell at cost to the government explosives or their nitrogenous content. It is to deliver such power as may be needed by the War Department to operate locks, lifts, etc.

Production, distribution and sale of electric power also is provided, this to be extended to states, counties municipalities, corporations, partnerships, or individuals.

Five per cent of the gross proceeds from the sale of power generated at Dam No. 2 in Alabama goes to the State of Alabama and 5 per cent of that from the Cove Creek Dam, whose construction is provided for, to the State of Tennessee. Of the excess power generated at Dam No. 2, upon completion of Cove Creek Dam, 2.5 per cent of the proceeds go to Alabama and 2.5 per cent to Tennessee.

An appropriation of $10,000,000 is authorized to carry out the program, $2,000,000 to be available for building Cove Creek Dam on the Clinch River in Tennessee.

The President is given the right for one year after passage of the act to lease the plants at Muscle Shoals for a term not to exceed 50 years, the provisions for activities of the proposed corporation to be suspended until the 12-month period is concluded.

French Rayon Industry May Join Cartel

From Our Paris Correspondent

RAYON producers have found but little improvement in their business. Sales continue on a restricted scale and stocks now accumulated in the different producing countries are estimated at about 40,000 tons. Producers in Germany, Holland, and Switzerland have reached an agreement, the result of which has been the formation of a common sales syndicate which is to continue for a period of ten years. Negotiations were recently conducted in Berlin between representatives of the French industry and the German syndicate of viscose rayon producers with a view of including France as a member of the international sales organization. The conference did not result in any definite agreement, but the opinion is expressed that France may eventually join the cartel if satisfactory concessions are made regarding the quotas allotted to the different producing countries.

Considerable study has been given in France of late with a view of developing insecticides and fungicides which would check deterioration and loss in growing vegetables, fruits, and other agricultural products. The work of Messrs. Truffaut and Pastac in developing the use of organic dyestuffs as curative agents for diseases in agricultural products has attracted wide attention. The dye solutions are applied as sprays and their application on fruit trees is reported to have given more satisfactory results than had been effected by the use of previously developed sprays. Auramine and brilliant acridine orange have been used to advantage but most successful results have come from the application of "elgetol," the composition of which has not been divulged.

Protection against damage to growing products from night frosts also has been a subject of study. As a result production of artificial fogs has gained prominence. Special devices have been evolved and the process used consists in dropping a compound such as chlorhydrin on chalk in an appropriate apparatus. The chalk thus heated throws off hydrochloric acid and other matters which mix with the damp air and produce intense opaque fogs. Despite the acidity of these dense vapors, their action on vegetation is not harmful. It is now held that these vapors can be made more serviceable if they are given properties destructive to parasitic growths.

Attempts to foster the growth of vineyards and other agricultural products in France assume more importance when it is understood that such products form an important part in the economic structure of the country. French exportations of wine last year were cut down materially, yet they reached a total of 818,000 hectoliters. Production of alcohol amounted to 3,622,750 hectoliters. Alcohol used in making spirits is produced by distilling wine, but industrial alcohol is obtained from sugar beets, molasses, and as a byproduct from sugar manufacture. It also is made from grains and potatoes, as well as by distilling apple and pear juice.

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M.I.T. Arranges Courses In Five Major Groups

AT A meeting held an March 9, a new plan of administrative organization for Massachusetts Institute of Technology was adopted. According to the new plan the courses will be divided into five major branches, the School of Science, School of Engineering, School of Architecture, Division of Humanities, and Division of Industrial Cooperation.

Full recognition of the graduate school also is included in the plan. The graduate school already had held a very prominent position among institutions granting advanced degrees in engineering but did not have the status of a separate unit which it will now assume.

Karl T. Compton, president of the institute, in a statement bearing on the new arrangement said:

"The new plan of administrative organization of the institute is a natural extension of the administrative plan begun two years ago with the appointment of a chairman of the corporation as well as a president of the institute.

"The subdivision of the institute, for administrative purposes, into the School of Engineering, the School of Science, the School of Architecture, the Division of Humanities, and the Division of Industrial Cooperation, recognizes the five major aspects of its work. The three schools comprise those departments of study in which degrees are given, whereas the two divisions are essentially 'service' divisions. That of humanities is designed to give our students that further cultural training and background which we deem an essential part of a well-balanced training.

"The Division of Industrial Cooperation is designed to make as effective as possible the assistance which the institute renders in a variety of ways to business and industry in solving their technical problems."

President Compton also announced the appointment of Dr. Vannevar Bush, member of the faculty of electrical engineering for the last nine years, as vice-president and dean of engineering. Dr. Samuel C. Prescott was appointed dean of science and Prof. William Emerson, dean of architecture.

British Columbia Plant Exports Fertilizer

A news item in the Vancouver press states that Pacific Coast Terminals, Ltd., New Westminster, is handling the exports of fertilizer materials produced at the Consolidated Mining & Smelting Co.'s plant at Tadanac, British Columbia. The press reports exports of over 2,000 tons of materials during the first six weeks of 1932. The Consolidated Mining & Smelting Co. produces ammonium sulphate and triple superphosphate. U. S. official statistics for December record exports of 9,162 long tons of high-grade hard rock shipped to Canada from the Montana and Idaho district.

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Midwest Regional Meeting Of A.C.S. at St. Louis

THE mid-west regional meeting of the American Chemical Society will be held at the Coronado Hotel, St. Louis, Mo., May 5-7. The program which has been arranged includes papers of unusual interest in the fields of petroleum, pharmaceutical, corn products, and chemical education. L. V. Redmond, president of the A.C.S., will be present and will be the speaker at the meeting on May 6, to which the public will be invited. On May 7 inspection trips will be taken to various industries in the St. Louis area.

At the annual meeting of the Technical Association of the Pulp and Paper Industry the following officers were elected for the ensuing year, reading from left to right: R. G. Macdonald, secretary; Allen Abrams, Marathon Paper Mills, president; and Clark C. Heritage, Oxford Paper Co., vice-president

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MEN
IN CHEMICAL ENGINEERING

W. F. REICH, JR., has been promoted to general sales manager of the Carbide and Carbon Chemical Corp., New York City, a position left vacant by the promotion of J. G. Davidson to vice-president.

ARTHUR K. DOOLITTLE, formerly of the Sherwin-Williams Co. and of the Bradley & Vrooman Co., has joined the Carbide & Carbon Chemicals Corp. at South Charleston, W. Va., for development work on protective coatings.

HARLAN A. DEPEW, formerly of the research department of the New Jersey Zinc Co. at Palmerton, Pa., has accepted a position on the research staff of the American Zinc Oxide Co., a subsidiary of the American Zinc, Lead & Smelting Co., Columbus, Ohio.

ARTHUR R. HITCH has joined the technical staff of the Ethyl Gasoline Corp. and is now located in Wilmington, Del. Dr. Hitch was with the laboratory of the DuPont company from 1920 to 1927 and since then has been associated with the Gillican-Chipley Co., New Orleans, La.

BRYSON GLASS, formerly with the research department of the Swann Corp., is temporarily connected with the research department of the Wallace-Tiernan Corp. at Belleville, N. J.

CHARLES L. JONES, formerly vice-president of the Dry-Ice Corp., is now vice-president and treasurer of the new Cold Carbonic Corp., New York City, which is distributing and developing new uses for solid carbon dioxide.

ARTHUR C. CARLTON, formerly of the Baltimore Copper Smelting & Rolling Co., has been appointed director of geology and mineralogy at the Chicago Industrial Museum, now in construction. He recently served as chairman on the Committee on Unemployment and Relief for Chemists and Chemical Engineers.

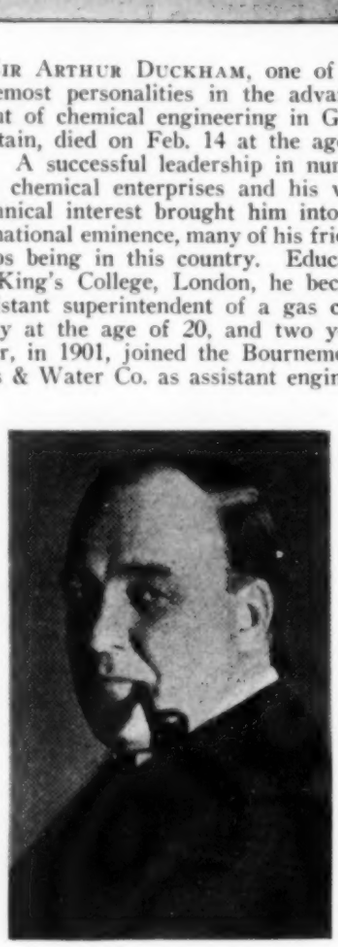
GEORGE M. NORMAN, who was head of the technical department of Hercules Powder Co., Wilmington, Del., has been appointed as manager of the development department. H. E. KAISER will henceforth supervise research and experiment, and G. E. RAMER, the engineering activities.

J. M. MCVEY has been appointed assistant manager of the development department of the Hercules Powder Co., Wilmington, Del.

OBITUARY

WILLIAM H. SCOTT, president of the Harper-Scott Paint Manufacturing Co. and secretary of the General Lead Co., died at his home in St. Louis, Mo., on Feb. 21, at the age of 63.

SIR ARTHUR DUCKHAM, one of the foremost personalities in the advancement of chemical engineering in Great Britain, died on Feb. 14 at the age of 53. A successful leadership in numerous chemical enterprises and his wide technical interest brought him into international eminence, many of his friendships being in this country. Educated at King's College, London, he became assistant superintendent of a gas company at the age of 20, and two years later, in 1901, joined the Bournemouth Gas & Water Co. as assistant engineer.



SIR ARTHUR DUCKHAM

Under H. W. Woodall, he collaborated in the design of the Woodall-Duckham vertical retort and subsequently in the formation of numerous companies that were to hold a leading position in the byproduct coal industries. After assisting the government in some of its chemical problems during the War, he returned to private industry and helped in the formation of the Institution of Chemical Engineers, of which he became first president in 1923. In 1928-1929 he was enrolled by the government again, however, as head of a commission for the study of Australian trade opportunities and industry.

BURROWS SLOAN, chairman of the board of General Refractories Co., Philadelphia, Pa., died on Feb. 28 in his 55th year. Mr. Sloan was a graduate from Princeton and was later associated with the Harbison-Walker Refractories Co., when in 1911 together with Governor Sproul, he organized the General Refractories Co., of Philadelphia. He became president in 1925, and chairman of the board in 1931.

SAMUEL W. WILEY, president of Wiley & Co., analytical and consulting chemists, died at his home near Baltimore, Md., on Feb. 23 from a heart attack. He was 54 years of age. The chief interest of his career had been the chemical aspects of the fertilizer industry. Born in Amherst, Mass., he was educated at the Massachusetts Agricultural College and Boston University before becoming assistant chemist at the Massachusetts State Experiment Station. From there he went to a post as chemist for the Bowker Fertilizer & Chemical Co., at Elizabeth, N. J., and in 1902 became chief chemist for the American Agricultural Chemical Co. With four years' experience there, he established his laboratories in Baltimore in 1906 and had continued in its direction ever since. Dr. Wiley was an active figure in many chemical societies and agricultural associations.

CLIFFORD RICHARDSON, chemical engineering authority on asphalt and lately retired, died in Paris on Feb. 28 at the age of 75. During his long professional life, Mr. Richardson had been active mainly in New York. Born and educated in Massachusetts, he was active for some years in the U. S. Geological service and then became superintendent of testing for the Barber Asphalt Paving Co. From 1900 to 1910, he was proprietor of the New York Testing Laboratory. An outgrowth of his work were several books on asphalt technology.

PHILIP E. DREESBACH, for 25 years associated with the chemical department of the Corn Products Refining Co., died at his home in Montclair, N. J., on Feb. 29 at the age of 66. Mr. Dreesbach, a native of Beardstown, Ill., was educated in Chicago and Berlin.

CALENDAR OF COMING EVENTS

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, spring meeting, Schenectady and Corning, N. Y., June 15-17.

AMERICAN CHEMICAL SOCIETY, 83d meeting, New Orleans, March 28-April 1.

AMERICAN INSTITUTE OF CHEMISTS, annual meeting, New York, May 7.

AMERICAN GAS ASSOCIATION, Atlantic City, June 3-4.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Atlantic City, N. J., June 20-24.

COLLOID SYMPOSIUM, American Chemical Society, Ottawa, Canada, June 16-18.

ELECTROCHEMICAL SOCIETY, spring meeting, Baltimore, April 21-23.

Income Returns Give Chemical and Allied Industries High Rating

THE Bureau of Internal Revenue has issued a very comprehensive report on incomes earned in 1929 as revealed by returns filed in compliance with income tax regulations. Corporation returns for manufacturing operations have been segregated into major industrial groups, of which chemicals and allied products constitute 7.77 per cent of the number of returns, 15.95 per cent of the gross income, and 17.48 per cent of the net income. Chemicals and allied products as grouped in the compilation, in addition to chemicals proper, include mineral oil refining, production of paints, oils, soaps, drugs, fertilizers, etc.

With the classification thus defined, gross and net incomes for the group for 1929 give the following data for the important producing states:

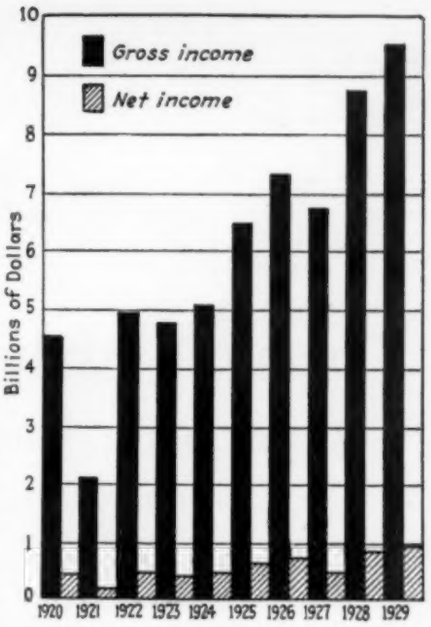
Production of Chemicals and Allied Products in 1929, by States

	Gross Income	Net Income
New York	$3,948,944,938	$343,946,191
Pennsylvania	872,797,078	84,784,962
Delaware	863,206,709	97,870,106
Illinois	813,712,211	100,498,344
Ohio	542,991,769	53,840,023
California	431,757,436	48,583,472
Texas	417,918,087	34,551,222
Oklahoma	215,900,751	17,693,674
Massachusetts	149,993,286	11,139,843
Missouri	147,846,517	12,973,845
Michigan	146,897,886	28,166,879
Connecticut	140,371,081	4,785,460
New Jersey	114,136,696	12,648,116
Kentucky	105,015,993	8,717,656
Total	$8,911,490,438	$860,199,793
Other states	639,054,288	51,312,277
Total	$9,550,544,726	$911,512,070

While manufacture of chemicals and allied products was reported for every state in the Union, the returns appear to stress the influence which proximity to consuming markets has exerted upon plant locations. The prominence of New York as a producing state may be due in part to natural power advantages as exemplified in the establishment of an electro-chemical industry in the Niagara district; Oklahoma and Texas undoubtedly owe their relatively high ranking to the inclusion of petroleum refining in the group classification with availability of raw materials as the principal geographical influence. However, the fact that the five states in which general manufacturing activities reach their highest volume also account for more than 73 per cent of the gross income from production of chemicals and allied products offers convincing proof that production has largely settled around consuming centers.

Growth of the group for the ten-year period ended 1929 is but partially reflected by a comparison of financial statements. The price index of the U. S. Department of Labor for 1920-1928 averaged 104.9, with 96.5 representing the average for 1929. *Chem. & Met.'s* weighted index number for chemicals in 1920-1928 averaged 114.88 and the average for 1929 was 100.10. It is evident, therefore, that the growth of the chemical and allied industry during the 1920-1929 period was larger from a volume standpoint than is indicated by the differences in annual gross incomes.

The financial set-up of the chemicals and allied products group places capitalization at $630,443,096 in preferred stock and $6,570,234,920 in common stock. Assets included investments of $348,208,155 in tax-exempt securities, $1,883,629,897 in other investments, and $6,073,064,903 in capital assets, buildings, and equipment. Adding miscellaneous assets, cash, accounts receivable, and inventories, total assets of $14,031,148,555 is reached.



Gross and Net Incomes for Chemical and Allied Industries

Corporation Income Tax Returns for 1929 Showing Analysis of Compiled Receipts, Deductions, Net Profits, and Tax

		Chemicals and Allied Products	*
A.	Receipts		
	Gross sales	$9,213,902,953	89.32
	Profit or loss from sales		
	Corporations reporting profit	3,016,215,695	32.74
	Corporations reporting loss	1,480,032	.02
	Profits less losses	3,014,735,663	32.72
	Gross profits from operations other than amounts tabulated as gross sales	475,808,745	4.61
	Interest	63,112,304	.61
	Rents	21,856,839	.21
	Profits from sale of real estate, stocks, bonds, and other capital assets	23,409,363	.23
	Miscellaneous receipts	155,247,603	1.50
B.	Receipts, tax-exempt income		
	Dividends on capital stock of domestic corporations	334,222,853	3.24
	Interest on federal, state, and municipal bonds	28,471,966	.28
C.	Total compiled receipts	$10,316,032,626	100.00
D.	Statutory deductions		
	Cost of goods sold	6,199,167,290	60.09
	Compensation of officers	94,001,533	.91
	Interest paid	117,153,228	1.13
	Taxes paid other than income tax	144,003,120	1.40
	Bad debts	30,612,838	.30
	Depreciation	416,296,965	4.04
	Depletion	172,487,020	1.67
	Miscellaneous deductions	1,925,080,174	18.66
E.	Total statutory deductions	$9,098,802,168	88.20
F.	Compiled net profits	1,217,230,458	11.80
G.	Deduction from net profits to arrive at net income as defined in revenue act: Tax-exempt interest and dividends received on capital stock of domestic corporations	362,694,819	29.80
H.	Statutory net income	854,535,639	70.20
I.	Net loss for prior year deducted by concerns reporting net income for 1929	16,509,969	1.36
J.	Statutory net income (H) after deducting net loss for prior year	838,025,670	68.84
K.	Total tax	98,124,032	8.06
L.	Compiled net profits (F) after deducting tax	1,119,106,426	91.94
	Cash and stock dividends distributed		
	Cash dividends	819,876,169	.....
	Stock dividends	189,687,691	.....
	Total dividends distributed	$1,009,563,860	

*Analysis of receipts, deductions and profits expressed as percentages of total receipts; also net income tax and profit expressed as percentages of net profits.

Group Income Returns for Chemicals and Allied Products

	Total Number of Returns	Corporations Reporting Net Income: Number of Returns	Gross Income	Net Income	Net Loss for Prior Year	Income Tax	Corporations Reporting No Net Income: Number of Returns	Gross Income	Deficit	No Income Data Reported, Number of Returns
Chemicals and allied products										
Petroleum and other mineral oil refining	640	319	$5,722,256,328	$478,446,143	$10,807,463	$51,387,925	254	$323,351,046	$21,430,294	67
Chemicals proper, acids, compounds, etc.	500	276	1,026,514,325	125,974,068	563,699	13,753,713	184	19,339,135	2,662,835	40
Allied chemical products—										
Drugs, oils, paints, soaps, and other allied products	6,042	3,267	2,628,366,911	297,357,893	4,834,065	31,957,876	2,466	350,792,415	31,303,110	309
Fertilizers	323	211	173,407,162	9,733,966	304,742	1,024,518	94	43,533,338	1,580,192	18
Total chemicals and allied products	7,505	4,073	$9,550,544,726	$911,512,070	$16,509,969	$98,124,032	2,998	$737,015,934	$56,976,431	434

ECONOMIC INFLUENCES

on production and consumption of CHEMICALS

Chemical Production at Higher Operating Rate Last Month

Actual Output Without Adjustment for Working Days Shows Decline

WITHOUT attempting to make allowance for the reduction in the number of working days, production of chemicals in February as deduced from consumption of electrical energy was represented by the index number 120.6, which is a drop of 3.3 per cent from the figure for the preceding month. Adjustments for the comparative working periods make it apparent that the rate of operations was speeded up last month. In some cases the handicap of fewer working hours was more than overcome and different individual companies reported a gain in actual output for the month.

General industrial developments have indicated that consuming industries were working into a more favorable position. The automotive trade, which offers a wide outlet for a varied line of chemical products, is expected to show marked progress in the present month. Window-glass producers have taken steps to stabilize that industry and have put into effect a price advance of 10 per cent, which was followed by a gain in buying orders. Plate-glass production has been increased in the last two weeks and demand for glass containers is said to be gaining in volume.

THE fertilizer industry has lived up to earlier predictions and tag sales in 16 states in February were reported by the National Fertilizer Association at approximately 60 per cent of those for February last year. Ordinarily about 18 per cent of the year's tag sales in the 13 Southern states are recorded in February. Some prospect for improvement is seen in a report from Texas which states that as a result of an arrangement worked out by Texas bankers and the Certified Cottonseed Breeders' Association, any farmer in Texas may purchase certified cottonseed for his 1932 planting without cash outlay. The farmer may pay for his seed after the crop is sold next fall.

From statistics now available it is possible to form a fairly definite opinion regarding the change in the status of chemical production and chemical distribution for January, last, compared with January, 1931. The following figures indicate the relative changes:

	Jan., 1932	Jan., 1931
Production		
Arsenic, crude, tons	2,065	2,803
Arsenic, ref., tons	857	1,570
Automobiles —		
Passenger cars, No.	98,706	137,805
Trucks, No.	20,541	33,531
Taxicabs, No.	97	512
Byproduct coke, 1,000 tons	2,101	3,092
Cottonseed oil, cr., 1,000 lb.	185,977	182,357
Cottonseed oil, ref., 1,000 lb.	155,577	149,906
Explosives, 1,000 lb.	18,175	24,056
Glass containers, 1,000 gr.	1,606	1,776
Glass, plate, 1,000 sq.ft.	5,500	7,321
Leather, sole and belting in process, 1,000 lb.	63,770	73,261
Leather, upper in process, 1,000 lb.	120,178	129,513
Tires, 1,000	2,770	2,940
Sulphuric acid produced in fertilizer trade, tons	117,952	184,036
Consumption		
Cotton, bales	435,337	450,117
Silk, bales	58,793	55,910
Wool, 1,000 lb. gr. equiv.	34,253	33,856
Sulphuric acid in fertilizer trade, tons	92,610	202,640

It will be noted that the textile trade has held up in a very satisfactory way with a moderate decline in consumption of cotton and slight gains in consumption of silk and wool. The comparison in other industries is all in favor of January, 1931.

EXPORT demand for chemicals, as measured by outward shipments in January, gives but little promise of material improvement in the near future. Total value of chemical exports for that month was reported at $6,542,639, which compares respectively with $8,902,031 and $6,829,922 for January and December, 1931. The decline in export trade was general throughout the different groups of the general classification, the comparison being between January, 1932, and January, 1931. In the coal-tar group, a very sharp drop was noted in the case of benzol but a larger increase was reported in shipments of crude coal tar. Exports for the industrial chemical group were valued at $1,467,801 for January last, and $1,671,548 for January, 1931. The soda group made a favorable showing, exports totaling 42,019,049 lb. in January and 39,725,299 lb. in the same month a year ago. Bichromate, silicate, and borax figured largely in the increase, with a sharp decline in shipments of soda ash and niter cake.

In the pigment group, appreciable declines were registered for zinc oxide, lithopone, and lampblack, the group as a whole showing a drop of $582,803 in value. Fertilizers and fertilizer materials followed the general trend with total exports valued at $978,096, compared with $1,044,447 for January, 1931.

Imports of chemicals likewise fell below those of January, 1931, the values being $4,791,003 and $7,166,299, respectively. A gain was recorded, however, in comparison with December totals. In the coal-tar group an increase over January of last year was reported for dyes and colors, with declines for other products, although creosote oil still figures prominently in import trade. In the industrial chemical group, imports in January included notable gains over the corresponding period of last year in arsenic, tartaric acid, ammonium nitrate, carbonate of potash, salt cake, sodium cyanide, and a very marked increase in arrivals of copper sulphate.

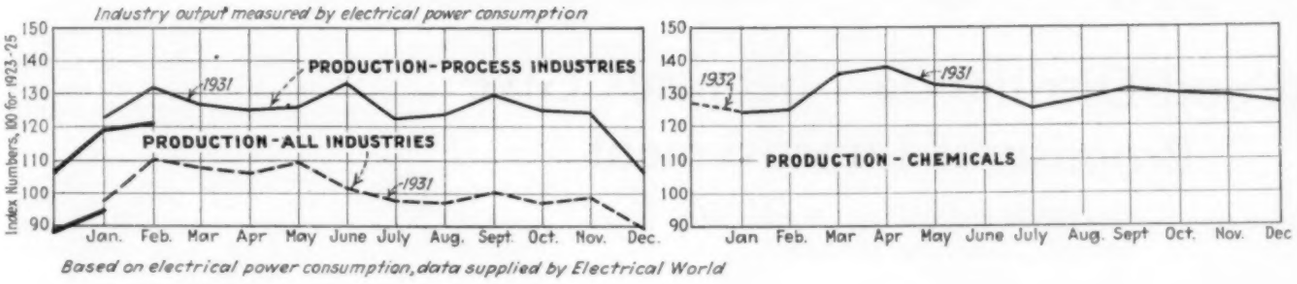
Considerable increases also were reported for the inward movement of zinc oxide, lithopone, and iron oxides in the pigment group. Import trade in fertilizers showed a decidedly downward trend, with the exception of sulphate of ammonia, of which 19,187 tons was imported in January last, compared with 13,742 tons in January, 1931. It is worthy of note that imports in January were valued at an average of $22.70 a ton while those for January, 1931, averaged $37.46 a ton.

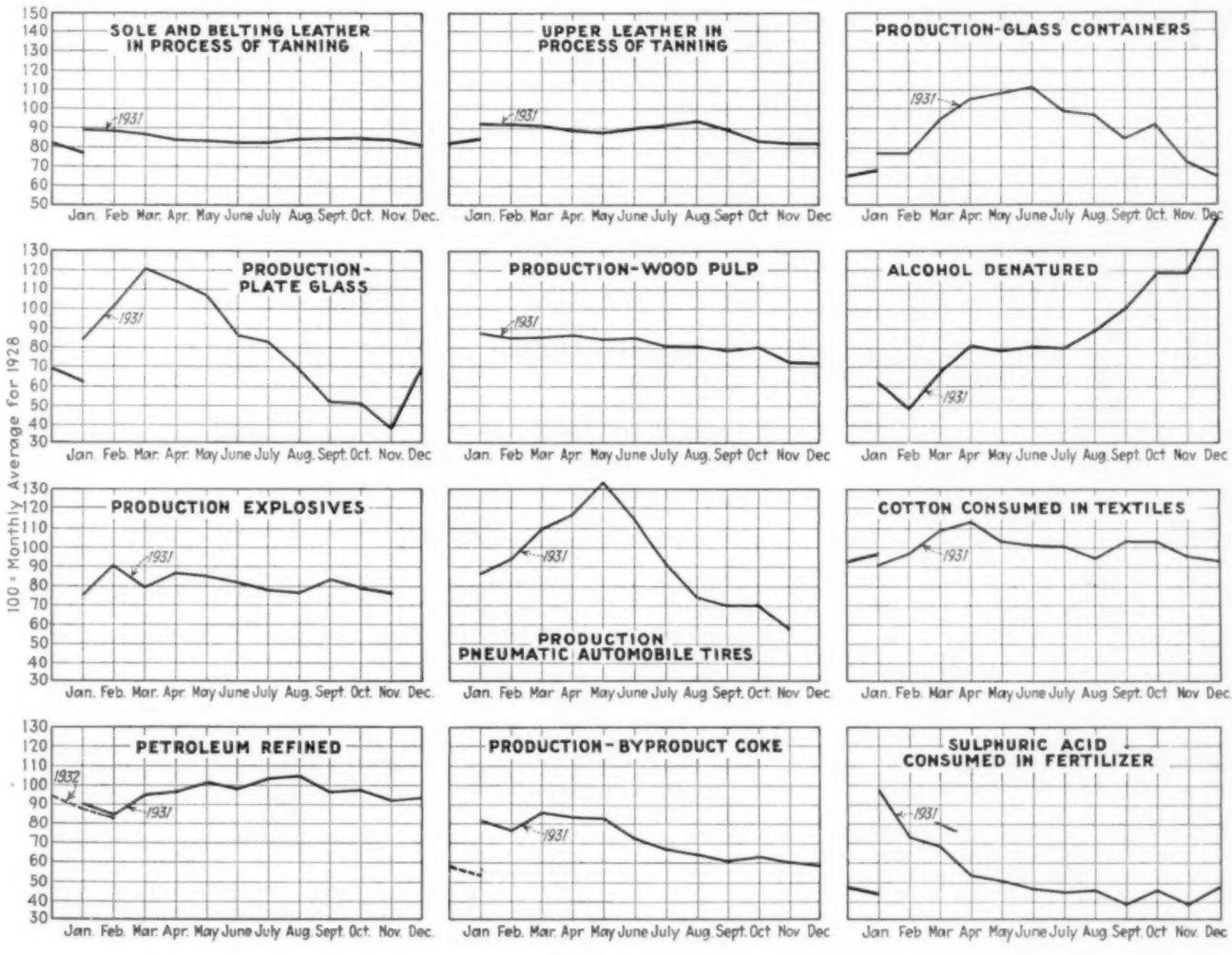
❖

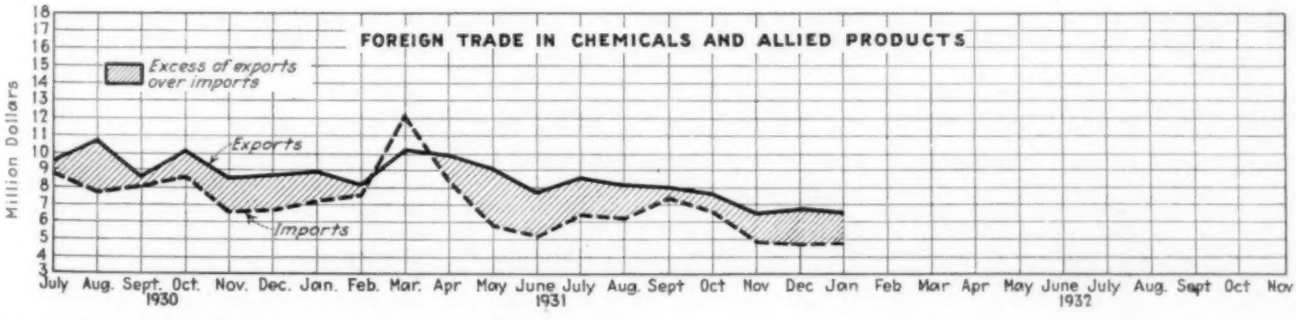
Canadian Oil Refinery Under Expansion

AN 800-bbl. Leamon cracking unit at the plant of the Northwest Stellarene Co., at Coutts, Alberta, is being rebuilt into a 1,200-bbl. Dubbs cracking unit. The Northwest Stellarene Co. was formerly known as the Beaver Refining Co. It is expected to operate the plant on oil from the Kevin-Sunburst field of Montana. It will operate on the full flashing system. Hot oil pumps, new reaction chamber, flash chamber and heat exchanger equipment are being installed. It is expected to have the unit in operation in May.

ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES


Industry output measured by electrical power consumption
Index Numbers, 100 for 1923-25
PRODUCTION-PROCESS INDUSTRIES
PRODUCTION-ALL INDUSTRIES
1931
PRODUCTION-CHEMICALS
1932
Jan. Feb. Mar Apr May June July Aug. Sept. Oct. Nov. Dec.
Based on electrical power consumption, data supplied by Electrical World




FOREIGN TRADE IN CHEMICALS AND ALLIED PRODUCTS
Excess of exports over imports
Exports
Imports
Million Dollars
July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr May June July Aug. Sept Oct Nov Dec Jan Feb Mar Apr May June July Aug. Sept Oct Nov
1930
1931
1932

MARKET CONDITIONS —AND PRICE TRENDS

Wood-Distillation Chemicals Give Promise of Improvement

Better Outlook for Acetate of Lime and Methanol

MODERATE improvement has been evident throughout the market for chemicals in the last few weeks. Different consuming industries have enlarged operations and contract deliveries of raw materials have gained in volume. The rate of increase, however, has been less than seasonal and it is evident that production schedules are being regulated to prevent accumulations of stocks at producing points.

A more encouraging outlook is reported for the wood-distillation chemicals. Stocks of acetate of lime at the beginning of 1931 were 19,266,386 lb. and at the end of March they had increased to 28,687,087 lb. Curtailed production from that time on brought steady reductions in the visible supply, and stocks of only 8,733,949 lb. were carried over into the present year. Further inroads on these unsold supplies were made in the last two months, and improved demand combined with the change in the statistical position resulted last week in an advance of 50c. per 100 lb. in the selling price. Prospects for a larger distribution of methanol likewise were held out by an announcement that this product could now be used as a denaturant for ethyl acetate. The general dissatisfaction which has been expressed for industrial alcohol, denatured under the present regulations, has given rise to hopes that methanol will be restored to its former position as a denaturant and thus may regain the large outlet formerly enjoyed in the anti-freeze trade. Incidentally it was announced that a wood-distillation plant in Pennsylvania which had been idle for many months had passed to new ownership and would again be placed in operation.

NITROGEN-BEARING materials continue to hold a prominent place in the market. Imported sulphate of ammonia is reaching domestic markets in large volume and the competition thus offered is a disturbing price factor. During the last month offerings c.i.f. Atlantic ports were available at prices lower than had previously been quoted, and unless there is a change in the situation foreign-made sulphate promises to cut deeply into our markets.

Nitrate of soda also was of interest, partly because of the situation in Chile and partly because of developments in domestic markets. The continuance of Cosach as a controlling factor in the nitrate industry in Chile has been threatened for some time, but, according to reports emanating from that country last week, the question has been settled at least for the present by the acceptance on the part of the Chilean government of plans submitted by Cosach representatives, and the latter combination will continue to function, with the probability that attempts will be made to formulate a working agreement with producers of the synthetic product.

Main interest in nitrate locally was found in reports that large unsold lots were being pressed for sale. Rumors were heard to the effect that large quantities of nitrate stored in this country had been carrying bank loans and that the calling of these loans was forcing liquidation which might disregard existing prices.

Following the price advance in acetate of lime, producers of acetic acid revised their sales schedules upward, the advance ranging from 25c. per 100 lb. upward according to grade. Demand for this acid has not been unusually heavy and the new sales schedules are due entirely to the higher cost of production.

DEVELOPMENTS in the market for China wood oil in the last month were marked by a tank-car shipment of 8,000 gal. from Gainesville, Fla., to Cartaret, N. J. This was the first large shipment of domestic-produced wood oil. A report from Florida also stated that plans were under way for the establishment of a 50,000-acre wood oil plantation in west Florida. The project is said to be financed by European capital, with an anticipated expenditure of close to $2,000,000.

Soap makers have been interested in a transaction which has become a matter for legal interpretation. A Norwegian whaler, under contract with an American soap company delivered a cargo of whale oil rendered aboard ship in Ross Sea, Antarctic, and now the courts with the assistance of eminent constitutional authorities, have to decide the question whether this oil is subject to import duty.

From their inception the tariff laws have assessed duties upon products "imported from any foreign country into the United States," and lawyers for the soap company argued before the U. S. Court of Customs Appeals that duty could not be assessed, as neither the tariff nor international law could be stretched to define Ross Sea or any part of the high seas as a part of a foreign country. The case came to the higher court from the Customs Court in New York, which held that the oil should be considered as an import from Norway, the country of registry of the ship, but the defense cited numerous decisions of U. S. courts and precedents in international law to show that ships have never been considered a part of the country in which they are registered. This was conceded by Charles D. Lawrence, Assistant Attorney General, who contended, however, that every law should be interpreted in the light of the probable intent of Congress.

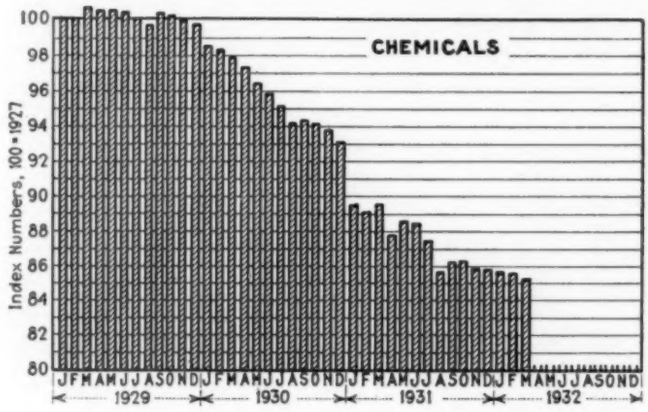
Investigation of nearly thirty phases of the naval stores trade, in an effort to reduce enormous wastes in this industry, is now being conducted by the Department of Agriculture. Dr. W. W. Skinner, of the Bureau of Chemistry and Soils of the department, is in charge of the work.

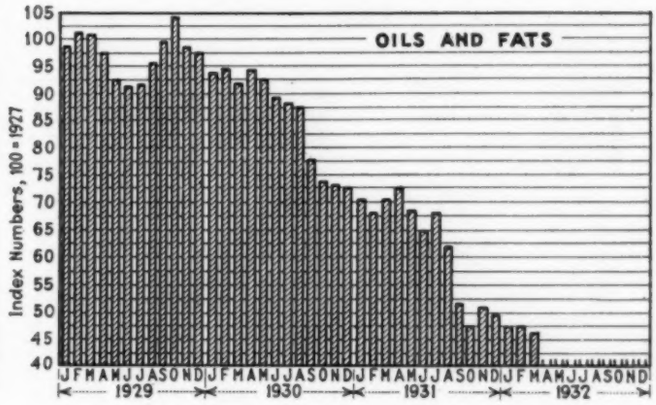
Preliminary work of the bureau has indicated that under unfavorable conditions a large part of the turpentine produced by the pine tree may be lost after the sap exudes from the tree and before the turpentine is recovered in the barrel.

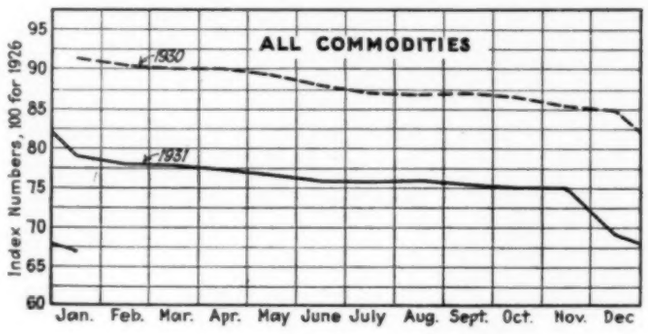
Japan Increases Output Of Soda Ash

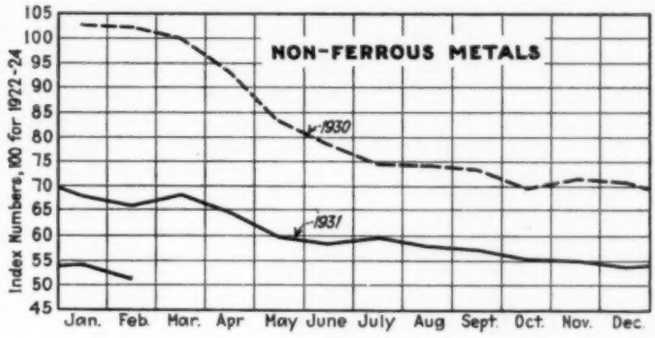
A report to the Department of Commerce from Japan says that during 1931 both the Asahi Glass Manufacturing Co. and the Dainihon Kali K. K. increased production of soda ash so that the total for that year was 80,000 metric tons, compared with 60,000 tons in 1930. It is now reported that the Asahi Glass Manufacturing Co. will produce some 60,000 tons during the current year and the Dainihon Kali K. K. will produce an equal amount, making a total of 120,000 tons. The 1931 import figures for soda ash are not available. In 1930, there was a decline to 72,000 tons from 87,200 tons in 1929.

CHEM. & MET. *Weighted Indexes of* PRICES









Values for Chemical Products Show No Decided Trend

PRICE developments in the market for chemicals last month were not of a nature to indicate any decided trend. The weighted index number was lowered, but this was due largely to keener foreign competition, which brought still lower prices for sulphate of ammonia, and to a rather sharp downward revision in the sales schedule for zinc oxide. Zinc oxide had maintained a steady price position in recent years and the new quotations represent largely a matter of readjustment of values based on reduced production costs, although recent reductions in prices for competing materials may have had some influence. With these exceptions there were no important price changes. Different chemicals have been subject to price-cutting, as has been the case for a long time, and the continuance of this practice is an indication that trading has not been active enough to point to any near-by advance in the price level.

Announcement of prices for denatured alcohol for delivery over the second quarter are awaited with interest, principally because consumers are hopeful of a decline from present levels because resale offerings have been weakening the position of producers.

With the fertilizer trade cutting down purchases and with sulphate of ammonia at low levels, nitrate of soda may be cited as one of the important materials which may have difficulty in holding its price position. In fact, rumors have been current to the effect that holders of large stocks stored along the Atlantic seaboard are now trying to reduce their holdings.

On the other hand, naval stores, which have been suffering from large accumulations, have shown a marked improvement in selling prices, and as it is now reported that the stocks held by Southern banks will be liquidated through regular channels, the control of supplies can be maintained with a strong possibility of a steadier market.

Mercury is another product which is recovering from the low prices reached in recent months and, with stocks declining, it is predicted that much higher prices will become effective before the end of the present month.

Metal salts also may be included among the products in which price advances are probable. White lead and zinc oxide undoubtedly will be unchanged for some time, but copper salts and tin products should work into a position where higher prices will prevail.

Vegetable oils and animal fats show no indications of a radical departure from their present position and probably will not improve until foreign markets show more activity.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

This month	**85.29**
Last month	85.70
March, 1931	89.72
March, 1930	97.90

Price fluctuations varied, but favored a lower level. Turpentine was higher, but resale lots took the edge off alcohol prices. Sulphate of ammonia was lower and zinc oxide was cut three-quarters of a cent a pound for all grades.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1927

This month	**46.34**
Last month	47.47
March, 1931	70.57
March, 1930	91.79

While some of the oils showed an occasional tendency toward firmness, the market was soft for the greater part of the month. Tallow, oleo oil, and glycerine also reached lower price levels. Olive oil foots closed at an advance.

CURRENT PRICES *in the* NEW YORK MARKET

THE following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to March 11.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.10 -$0.11	$0.10 -$0.11	$0.10.-$0.11
Acid, acetic, 28%, bbl., cwt.	2.75 - 3.00	2.40 - 2.65	2.60 - 2.85
Glacial 99%, tanks	8.10 -	8.10 -	8.98 -
drs	8.35 - 8.60	8.35 - 8.60	9.23 - 9.48
U. S. P. reagent, c'bys	8.85 - 9.10	8.85 - 9.10	9.73 - 9.98
Boric, bbl., lb.	.06½- .07	.06½- .07	.06½- .07
Citric, kegs, lb.	.33½- .35	.33½- .35	.40 - .41
Formic, bbl., lb.	.10 - .11	.10 - .11	.10 - .11
Gallic, tech., bbl., lb.	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb., lb.	.06 - .07	.06 - .07	.06 - .07
Latic, 44%, tech., light, bbl., lb.	.11½- .12	.11½- .12	.11½- .12
22%, tech., light, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Muriatic, 18° tanks, cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -	18.50 -20.00
Oxalic, crystals, bbl., lb.	.11 - .11½	.11 - .11½	.11 - .12
Phosphoric, tech., c'bys., lb.	.08½- .09	.08½- .09	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Sulphuric, 66°, tanks, ton	15.50 -	15.50 -	15.50 -
Tannic, tech., bbl., lb.	.23 - .35	.23 - .35	.23 - .35
Tartaric, powd., bbl., lb.	.24½- .25	.25½- .26	.30½- .33
Tungstic, bbl., lb.	1.40 - 1.50	1.40 - 1.50	1.40 - 1.50
Alcohol, ethyl, 190 p'f., bbl., gal.	2.33 -	2.33 -	2.63 - 2.71
Alcohol, Butyl, tanks, lb.	.143 -	.143-	.15½-
Alcohol, Amyl	-	-	-
From Pentane, tanks, lb.	.203-	.203-	.236-
Denatured, 188 proof			
No. 1 special dr., gal.	.34½-	.34½-	.39 -
No. 5, 188 proof, dr., gal.	.35½-	.35½-	.39 -
Alum, ammonia, lump, bbl., lb.	.03 - .04	.03½- .04	.03½- .04
Chrome, bbl., lb.	.04½- .05	.04½- .05	.04½- .05
Potash, lump, bbl., lb.	.03 - .04	.03½- .04	.03½- .04
Aluminum sulphate, com., bags, cwt.	1.25 - 1.40	1.25 - 1.40	1.25 - 1.40
Iron free, bg., cwt.	1.90 - 2.00	1.90 - 2.00	1.90 - 2.00
Aqua ammonia, 26°, drums lb.	.02½- .03	.02½- .03	.02½- .03
tanks, lb.	.02½- .02¾	.02½- .02¾	.02½- .02¾
Ammonia, anhydrous, cyl., lb.	.15½- .15¾	.15½- .15¾	.15½- .15¾
tanks, lb.	.05½-	.05½-	.05½-
Ammonium carbonate, powd. tech., casks, lb.	.10½- .11	.10½- .11	.10½- .11
Sulphate, wks., cwt.	1.00 -	1.10 -	1.60 -
Amylacetate tech., tanks, lb., gal.	.16 -	.16 -	.222-
Antimony Oxide, bbl., lb.	.06½- .08	.06½- .08	.08½- .10
Arsenic, white, powd., bbl., lb.	.04 - .04½	.04 - .04¼	.04 - .04½
Red, powd., kegs, lb.	.09 - .10	.09 - .10	.09 - .10
Barium carbonate, bbl., ton	56.50 -58.00	56.50 -58.00	58.00 -60.00
Chloride, bbl., ton	63.00 -65.00	63.00 -65.00	63.00 -65.00
Nitrate, cask, lb.	.07 - .07½	.07 - .07½	.07 - .07½
Blanc fixe, dry, bbl., lb.	.03¼- .04	.03¼- .04	.03¼- .04
Bleaching powder, f.o.b., wks., drums, cwt.	1.75 - 2.00	1.75 - 2.00	2.00 - 2.10
Borax, grain, bags, ton	50.00 -57.00	50.00 -57.00	50.00 -57.00
Bromine, cs., lb.	.36 - .38	.36 - .38	.36 - .38
Calcium acetate, bags	2.50 -	2.00 -	2.00 -
Arsenate, dr., lb.	.05½- .06¼	.06 - .07	.07 - .08
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton	18.00 -	18.00 -	20.00 -
flake, dr., wks., ton	21.00 -	21.00 -	22.75 -
Phosphate, bbl., lb	.08 - .08½	.08 - .08½	.08 - .08½
Carbon bisulphide, drums, lb.	.05 - .06	.05 - .06	.05 - .06
Tetrachloride drums, lb.	.06½- .07	.06½- .07	.06½- .07
Chlorine, liquid, tanks, wks., lb.	.01½-	.01½-	.01½-
Cylinders	.04 - .06	.04 - .06	.04 - .06
Cobalt oxide, cans, lb.	1.35 - 1.45	1.35 - 1.45	1.75 - 1.85
Copperas, bgs., f.o.b. wks., ton	13.00 -14.00	13.00 -14.00	13.00 -14.00
Copper carbonate, bbl., lb.	.07 - .16	.07 - .16	.08½- .18
Cyanide, tech., bbl., lb.	.39 - .44	.39 - .44	.41 - .46
Sulphate, bbl., cwt.	2.75 - 2.90	3.10 - 3.25	4.25 - 4.50
Cream of tartar, bbl., lb.	.19½- .19½	.19½- .19½	.23½- .24
Diethylene glycol, dr., lb.	.14 - .16	.14 - .16	.14 - .16
Epsom salt, dom., tech., bbl., cwt.	1.70 - 2.00	1.70 - 2.00	1.70 - 2.00
Imp., tech., bags, cwt.	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums, lb.	.10 -	.10 -	.085-
Formaldehyde, 40%, bbl., lb.	.06 - .07	.06 - .07	.06 - .07
Furfural, dr., contract, lb	.10 - .17½	.10 - .17½	.10 - .17½
Fusel oil, crude, drums, gal.	1.10 - 1.20	1.10 - 1.20	1.30 - 1.40
Refined, dr., gal.	1.80 - 1.90	1.80 - 1.90	1.90 - 2.00
Glaubers salt, bags, cwt.	1.00 - 1.10	1.00 - 1.10	1.10 - 1.20
Glycerine, c.p., drums, extra, lb.	.11½- .11¾	.11½- .11¾	.12½- .13
Lead:			
White, basic carbonate, dry casks, lb.	.06½-	.06½-	.07½-
White, basic sulphate, sck., lb.	.06 -	.06 -	.07 -
Red, dry, sck., lb.	.06½-	.06½-	.08 -
Lead acetate, white crys., bbl., lb.	.10½- .11	.10½- .11	.11 - .12
Lead arsenate, powd., bbl., lb.	.10 - .14	.10 - .14	.13 - .14
Lime, chem., bulk, ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk, lb.	.05½-	.05½-	.07 -
Lithophone, bags, lb.	.04½- .05	.04½- .05	.04½- .05
Magnesium carb., tech., bags, lb.	.05½- .06	.05½- .06	.06 - .06½
Methanol, 95%, tanks, gal.	.33 -	.33 -	.38 -
97%, tanks, gal.	.34 -	.34 -	.39 -
Synthetic, tanks, gal.	.35½-	.35½-	.40½-
Nickel salt, double, bbl., lb.	.10½- .11	.10½- .11	.10½- .11
Single, bbl., lb.	.10½- .11	.10½- .11	.10½- .11
Orange mineral, csk., lb.	.09½-	.09¼-	.10 -
Phosphorus, red, cases, lb.	.42 - .44	.42 - .44	.42 - .44
Yellow, cases, lb.	.31 - .32	.31 - .32	.31 - .32
Potassium bichromate, casks, lb.	.08 - .08½	.08 - .08½	.09 - .09½
Carbonate, 80-85%, calc., csk., lb	.05 - .05½	.05 - .05½	.05½- .06
Chlorate, powd., lb.	.08 - .08½	.08 - .08½	.08 - .08½
Cyanide, cs., lb.	.55 - .57	.55 - .57	.55 - .57
First sorts, csk., lb.	.08½- .09	.08½- .09	.08½- .09
Hydroxide (c'stic potash) dr., lb.	.06½- .06¾	.06½- .06¾	.06½- .06¾
Muriate, 80% bgs., ton	37.15 -	37.15 -	37.15 -
Nitrate, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Permanganate, drums, lb.	.16 - .16½	.16 - .16½	.16 - .16½
Prussiate, yellow, casks, lb.	.18½- .19½	.18½- .19	.18¼- .19
Sal ammoniac, white, casks, lb.	.04½- .05	.04½- .05	.047- .05
Salsoda, bbl., cwt.	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton	16.00 -18.00	16.00 -18.00	15.00 -18.00
Soda ash, light, 58%, bags, contract, cwt.	1.15 -	1.15 -	1.15 -
Dense, bags, cwt.	1.17½-	1.17½-	1.17½-
Soda, caustic, 76%, solid, drums, contract, cwt.	2.50 - 2.75	2.50 - 2.75	2.50 - 2.75
Acetate, works, bbl., lb.	.05 - .06	.05 - .06	.04½- .05
Bicarbonate, bbl., cwt.	1.85 - 2.00	1.85 - 2.00	1.85 - 2.00
Bichromate, casks, lb.	.05 - .06	.05 - .06	.07 - .07½
Bisulphate, bulk, ton	14.00 -16.00	14.00 -16.00	14.00 -16.00
Bisulphite, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Chlorate, kegs, lb.	.05½- .07½	.05½- .07¼	.05½- .07½
Chloride, tech., ton	12.00 -14.75	12.00 -14.75	12.00 -14.00
Cyanide, cases, dom., lb.	.15½- .16	.15½- .16	.16½- .17
Fluoride, bbl., lb.	.07½- .08	.07½- .08	.08 - .09
Hyposulphite, bbl., lb.	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Nitrate, bags, cwt.	1.77 -	1.77 -	2.05 -
Nitrite, casks, lb.	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb.	2.55 - 2.75	.0265 - .03	.0265 - .03
Prussiate, yel. drums, lb.	.11½- .12	.11½- .12	.11½- .12
Silicate (30°, drums), cwt.	.60 - .70	.60 - .70	.60 - .70
Sulphide, fused, 60-62%, dr., lb.	.02½- .03¼	.02½- .03	.02¾- .03
Sulphite, cyrs., bbl., lb.	.03 - .03¼	.03 - .03¼	.03 - .03½
Sulphur, crude at mine, bulk, ton	18.00 -	18.00 -	18.00 -
Chloride, dr., lb.	.05 - .06	.05 - .06	.05 - .06
Dioxide, cyl., lb.	.06½- .07	.06½- .07	.06½- .07
Flour, bag, cwt.	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl., lb.	nom.-	nom.-	nom.-
Oxide, bbl., lb.	.25½-	.24½-	.29¼-
Crystals, bbl., lb.	.23½-	.23½-	.26 -
Zinc chloride, gran., bbl., lb.	.06½- .06¾	.06½- .06¼	.06½- .06¾
Carbonate, bbl., lb.	.10½- .11	.10½- .11	.10½- .11
Cyanide, dr., lb.	.41 - .42	.41 - .42	.41 - .42
Dust, bbl., lb.	.05½- .06	.05½- .06	.06 - .07
Zinc oxide, lead free, bag, lb.	.05½-	.06½-	.06½-
5% lead sulphate, bags, lb.	.06½-	.06½-	.06½-
Sulphate, bbl., cwt.	3.00 - 3.25	3.00 - 3.25	3.00 - 3.25

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.09½-$0.10½	$0.09½-$0.10	$0.10½-$0.11
Chinawood oil, bbl., lb.	.07½-	.07½-	.07 -
Coconut oil, Ceylon, tanks, N. Y. lb.	.03¾-	.03½-	.04½-
Corn oil crude, tanks, (f.o.b. mill), lb.	.03½-	.03¼-	.07¼-
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.03½-	.03½-	.06½-
Linseed oil, raw, car lots, bbl., lb.	.067-	.064-	.094-
Palm, Lagos, casks, lb.	.03½-	.04 -	.06 -
Niger, casks, lb.	.03½-	.03½-	.05½-
Palm Kernel, bbl., lb.	.05½-	.05½-	.05½-
Peanut oil, crude, tanks (mill), lb.	.03½-	.03½-	.07 -
Rapeseed oil, refined, bbl., gal.	.39 - .41	.39 - .41	.56 - .58
Soya bean, tank (f.o.b. Coast), lb	nom.-	nom.-	nom.-
Sulphur (olive foots), bbl., lb.	.05 -	.04½-	.06½-
Cod, Newfoundland, bbl., gal.	.25 - .27	.25 - .27	.42 - .45
Menhaden, light pressed, bbl., gal.	.33 - .34	.33 - .34	.34 - .36
Crude, tanks (f.o.b. factory), gal.	.20 -	.20 -	.20 -
Whale, crude, tanks, gal.	nom.-	nom.-	- nom.
Grease, yellow, loose, lb.	.02 -	.02½-	.02½-
Oleo stearine, lb.	.04½-	.04½-	.07½-
Red oil, distilled, d.p. bbl., lb.	.06½-	.07½-	.08½-
Tallow, extra, loose, lb.	.02½-	.02½-	.03½-

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.14½- .15	.14½- .15	.15 - .16
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .52

Coal-Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr., lb.	$1.10 -$1.25	$1.10 -$1.25	$1.10 -$1.25
Benzidine base, bbl., lb.	.65 - .67	.65 - .67	.65 - .67
Benzoic acid, U.S.P., kgs, lb.	.48 - .52	.48 - .52	.57 - .60
Benzyl chloride, tech., dr., lb.	.30 - .35	.30 - .35	.30 - .35
Benzol, 90%, tanks, works, gal.	.20 - .21	.20 - .21	.20 - .21
Beta-naphthol, tech., drums, lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U. S. P., dr., lb.	.10½- .11	.10½- .11	.14 - .17
Cresylic acid, 97%, dr., wks., gal.	.49 - .52	.49 - .52	.54 - .58
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.55 - .58
Dinitrophenol, bbl., lb.	.29 - .30	.29 - .30	.29 - .30
Dinitrotoluen, bbl. lb.	.16 - .17	.16 - .17	.16 - .17
Dip oil 25% dr., gal.	.23 - .25	.23 - .25	.26 - .28
Diphenylamine, bbl., lb.	.38 - .40	.38 - .40	.38 - .40
H-acid, bbl., lb.	.65 - .70	.65 - .70	.65 - .70
Naphthalene, flake, bbl., lb.	.03½- .04½	.03½- .04½	.03½- .04½
Nitrobenzene, dr., lb.	.08½- .09	.08½- .09	.08½- .10
Para-nitraniline, bbl., lb.	.51 - .55	.51 - .55	.51 - .55
Para-nitrotoluine, bbl., lb.	.26 - .28	.29 - .31	.29 - .31
Phenol, U.S.P., drums, lb.	.14½- .15	.14½- .15	.14½- .15
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., lb.	1.50 - 1.75	1.50 - 1.80	1.50 - 1.80
R-salt, bbl., lb.	.40 - .44	.40 - .44	.40 - .44
Resorcinal, tech., kegs, lb.	.65 - .70	.70 - .80	1.15 - 1.25
Salicylic acid, tech., bbl., lb.	.33 - .35	.33 - .35	.33 - .35
Solvent naphtha, w.w., tanks, gal.	.26 -.....	.26 -.....	.25 - .30
Tolidine, bbl., lb.	.86 - .88	.86 - .88	.86 - .88
Toluene, tanks, works, gal.	.30 -.....	.30 -.....	.30 -.....
Xylene, com., tanks, gal.	.26 -.....	.26 -.....	.25 - .28

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$22.00-$25.00	$22.00-$25.00	$23.00-$25.00
Casein, tech., bbl., lb.	.07 - .14	.07½- .14	.08½- .11½
China clay, dom., f.o.b. mine, ton	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.03 - .20	.03 - .20	.03½- .20
Prussian blue, bbl., lb.	.35 - .36	.35 - .36	.35 - .36
Ultramine blue, bbl., lb.	.06 - .32	.06 - .32	.06 - .32
Chrome green, bbl., lb.	.27 - .28	.27 - .28	.27 - .30
Carmine red, tins, lb.	5.25 - 5.40	5.25 - 5.40	6.00 - 6.50
Para toner, lb.	.75 - .80	.75 - .80	.77 - .80
Vermilion, English, bbl., lb.	1.45 - 1.50	1.55 - 1.60	1.75 - 1.90
Chrome yellow, C. P., bbl., lb.	.16 - .16½	.16½- .17	.16½- .17
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 - .08½	.07 - .08½	.07 - .08½
Gum copal Congo, bags, lb.	.06 - .08	.06 - .08	.07 - .09
Manila, bags, lb.	.16 - .17	.16 - .17	.16 - .17
Damar, Batavia, cases, lb.	.16 - .16½	.16 - .19	.16 - .16½
Kauri No. 1 cases, lb.	.45 - .48	.45 - .48	.48 - .53
Kieselguhr (f.o.b. N.Y.), ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton	40.00 -.....	40.00 -.....	40.00 -.....
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	4.30 -.....	3.80 -.....	6.00 -.....
Turpentine, gal.	.44½-	.38½-	.53 -.....
Shellac, orange, fine, bags, lb.	.32 - .34	.32 - .34	.41 - .42
Bleached, bonedry, bags, lb.	.24 - .26	.24 - .26	.28 - .30
T. N. bags, lb.	.12 - .13	.12 - .13	.17 - .18
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton	8.00 - 8.50	8.00 - 8.50	9.50 -.....
300 mesh (f.o.b. Ga.), ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton	13.75 -.....	13.75 -.....	13.75 -.....

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl., lb.	$0.16 -$0.20	$0.16 -$0.20	$0.21 -$0.23
Beeswax, ref., light, lb.	.25 - .27	.25 - .27	.26 - .30
Candelilla, bags, lb.	.14 -.....	.14 -.....	.13½- .14
Carnuba, No. 1, bags, lb.	.23 - .24	.23 - .24	.21½- .22
Paraffine, crude			
105-110 m.p., lb.	.03½- .03¼	.03½- .04¼	.03¼- .03½

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton	$200.00-.....	$200.00-.....	$200.00-.....
Ferromanganese, 78-82%, ton	75.00-80.00	80.00-85.00	80.00-85.00
Ferrochrome, 65-70%	.11-.....	.11-.....	.....-.....
Spiegeleisen, 19-21% ton	27.00-.....	30.00-.....	30.00-.....
Ferrosilicon, 14-17%, ton	31.00-.....	31.00-.....	39.00-.....
Ferrotungsten, 70-80%, lb.	1.00- 1.10	1.00- 1.10	1.10-.....
Ferrovanadium, 30-40%, lb.	3.05- 3.40	3.15- 3.50	3.15- 3.50

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb.	$0.06½-.....	$0.06 -.....	$0.10½-.....
Aluminum, 96-99%, lb.	.233-.....	.233-.....	.233-.....
Antimony, Chin. and Jap., lb.	.06½-.....	.06½-.....	.07½-.....
Nickel, 99%, lb.	.35 -.....	.35 -.....	.35 -.....
Monel metal blocks, lb.	.28 -.....	.28 -.....	.28 -.....
Tin, 5-ton lots, Straits, lb.	.22½-.....	.20½-.....	.2715-.....
Lead, New York, spot, lb.	.03½-.....	.0375-.....	.045-.....
Zinc, New York, spot, lb.	.0317-.....	.0345-.....	.0437-.....
Silver, commercial, oz.	.30½-.....	.30 -.....	.0294-.....
Cadmium, lb.	.55 -.....	.55 -.....	.55 -.....
Bismuth, ton lots, lb.	1.50 -.....	1.50 -.....	1.25 -.....
Cobalt, lb.	2.50 -.....	2.50 -.....	2.50 -.....
Magnesium, ingots, 99%, lb.	.30 -.....	.30 -.....	.48 -.....
Platinum, ref., oz.	37.50 -.....	40.00 -.....	30.00-.....
Palladium, ref., oz.	19.00 - 21.00	19.00 - 21.00	19.00- 21.00
Mercury, flask, 75 lb.	70.00 -.....	65.00 - 66.00	100.00-.....
Tungsten powder, lb.	1.45 -.....	1.45 -.....	1.65-.....

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton	$6.50 -$8.25	$6.50 -$8.25	$6.50 -$8.25
Chrome ore, c.f., post, ton	17.00 -20.00	17.00 -20.00	19.50 -24.00
Coke, fdry., f.o.b. ovens, t	3.25 - 3.75	3.25 - 3.75	2.75 - 2.85
Fluorspar, gravel, f.o.b. Il., ton	17.25 -20.00	17.25 -20.00	17.25 -20.00
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit	.25 - .26	.25 - .26	.25 - .27
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb.	.45 -.....	.45 -.....	.35 - .40
Monazite, 6% of ThO_2, ton	60.00 -.....	60.00 -.....	60.00 -.....
Pyrites, Span. fines, c.i.f., unit	.13 -.....	.13 -.....	.13 -.....
Rutile, 94-96% TiO_2, lb.	.10 - .11	.10 - .11	.10 - .11
Tungsten, scheelite, 60% WO_3 and over, unit	10.50 -12.00	10.50 -12.00	12.00 -12.50

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

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Aluminum Paint Manufacturing Plant—United Soviet Socialist Russia, c/o Amtorg Trading Corp., 261 5th Ave., New York, N. Y., plans construction of second unit to aluminum paint manufacturing plant at Leningrad. 8,000 tons of aluminum oxide and 4,000 tons metallic aluminum to be added to annual production. Work will be done by technical aid contracts. Maturity January, 1933.

Brick Plant—M. Lanz Brick & Tile Co., 2907 Carson St., Pittsburgh, Pa., awarded contract for construction of a 1 story, 40 x 60 ft. brick plant at Jane and 34th Sts., to Reliance Steel Co., Rankin. Estimated cost $50,000.

Cement Plant—Edison Cement Co., 261 5th Ave., New York N. Y., plans to remodel plant of Building Materials Corp. and constructing cement mill at New Brunswick, N. J. Estimated cost $500,000.

Cement Block Plant—N. P. Mogenson, Superior, Wis., will build a cement block manufacturing plant at Third St. North and Baxter Ave.

Chemical Plant — Buffalo Electro Chemical Co., Tonawanda, N. Y., awarded contract for construction of a storage and distribution building at Charlotte, N. C., to Jones Construction Co., Commercial Bank Bldg., Charlotte.

Chemical Manufacturing Plant—Merck & Co. Inc., Lincoln Ave., Rahway, N. J., will soon award contract for a 1 and 2 story addition to chemical manufacturing plant. Estimated cost $150,000. J. Salmond, Jr., 526 Elm St., Arlington, is architect.

Chemical Factory — Harry Siskin, 5702 Olympic Blvd., Los Angeles, Calif., plans completed for construction of a 1 story factory at 62nd St. and Central Ave. Estimated cost $75,000. John M. Cooper, 321 Rives-Strong Bldg., Los Angeles, is architect. Purex Chemical Co., 647 East Gage Ave., Los Angeles, lessee.

Coking Plant—United Soviet Socialist Russia, Leningrad Division of Peat Industry, c/o Amtorg Trading Corp., 261 5th Ave., New York, N. Y., plans construction of a peat coking plant in Khibini District, Kola Peninsula. Work will be done by day labor and technical aid contracts.

Coal Cleaning and Sizing Plant—Broad Top Coal Operators Association, Saxton, Pa., plans construction of a coal cleaning and sizing plant, 4,000 ton daily capacity. Coal mined in this district low ash and sulphur content, used mainly for metallurgical purposes. Estimated cost $1,500,000. Private plans. Committees investigating on machinery and equipment,

Charles F. Zimmerman, Pres. First National Bank, Huntington; I. Kay, Pres., Kay Coal Mining Co., Everett; W. W. Shannon, Saxton; B. Hudson, of Everett Saxton Co., Bedford; George Piling, Philadelphia and Chester Kangton, Huntingdon.

Fiber Products Plant—Fiberloid Corp., Indian Orchard, Mass., manufacturers of fiber products, awarded contract for a 1 story addition to storage and distribution building to Adams & Ruxton Construction Co., 1387 Main St., Springfield.

Gas Mixing Plant—Syracuse Lighting Co., 421 South Warren St., Syracuse, N. Y., plans construction of a mixing plant for natural and artificial gas, also 15 mile line from Onondaga to Syracuse. Application for permit now pending with Public Service Commission.

Gas Plant Addition—Cumberland County Gas Co., Millville, N. J., plans completed for a 2 story addition to gas plant and office on Second St. Estimated cost $40,000. Work will be done by separate contracts under the supervision of Ford, Bacon & Davis, 39 Broadway, New York, N. Y., Engrs.

Gas Purifier—Metropolitan Utilities District, 18th and Harney Sts., Omaha, Neb., plans construction of a gas purifier capable of eliminating sulphur and other impurities from 20 million cu.ft. of gas daily. Consists of 36 x 66 ft. steel purifier box and gantry crane for removing covers. C. D. Robinson, 18th and Harney Sts., Omaha, is engineer.

Garnet Deposits—Institute of Applied Mineralogy, Division of Soviet Government, c/o Amtorg Trading Co., 261 5th Ave., New York N. Y., plans construction of a plant for working of garnet deposits at Shuyeretskaya, Karelian Republic. Garnet is used in abrasive industry.

Gasoline Plant—Stock Co., c/o G. A. Griffin, Plant Supt., Kilgore, Tex., plans construction of a casinghead gasoline plant, 15,000 gal. daily capacity. Estimated cost $75,000. Equipment purchased.

Glass Plant—Carr-Lowrey Glass Co., Westport Md., plans additional unit to plant for the manufacture of bottles.

Glass Plant—Diamond Glass Ware Co., H. W. Thomas, 565 Water St., Indiana, Pa., plans to rebuild glass plant, 1 story, 88 x 150 ft. on College Ave., destroyed by fire. Engineer not selected. Maturity about April.

Glass Sand Mining Plant—Tavern Rock & Sand Co., T. A. Graham, Gen. Mgr., Millville, N. J., reported to have purchased 275 acres at Enterprise, Ky., on which it will erect a glass sand mining plant. Estimated cost $350,000.

Glue Factory—Canac-Marquis Glue Company, Quebec City, Que., plans erection of a factory at Ste. Marie d' 1 Incarnation St. Estimated cost $125,000. Equipment will be required.

Helium Building—Bureau of Yards & Docks, Navy Department, Washington, D. C., awarded contract for construction of a group of buildings, including helium building, storage building, boiler plant, etc., at Naval Air Station Sunnyvale, Calif., to Robert E. McKee, 108 West 6th St., Los Angeles, $64,300. Bids will be received until April 6 for equipment, high and medium pressure air and helium piping and accessories for purification of helium.

Hide and Tallow Plant—Binz Hide & Tallow Co., DeKalb and Zepp Sts., St. Louis, Mo., will soon award contract for a 1 and 2 story, 32 x 106 ft. addition to plant. Estimated cost $40,000. Charles L. Krause, 3944 Evans Ave., St. Louis, is architect.

Ink Plant—Hortman-Salmen Co. Inc., 3901 South Carrollton St., New Orleans, La., having plans prepared for construction of a 1 story, 60 x 200 ft. ink plant on South Jefferson Davis Parkway. Estimated cost $50,000. Rathbone De Buys, Hibernia Bldg., New Orleans, is architect.

Laboratory—School Committee, Weston, Conn., awarded contract for construction of a 1 story, 120 x 150 ft. school including laboratory, etc., to William Martin & Son, 164 State St., Bridgeport. Former contract rescinded.

Laboratory Equipment—A. & M. College, College Station Tex., awarded contract for laboratory equipment for chemistry building to W. M. Welch Manufacturing Co., Manitowoc, Wis. $32,623.

Laboratories (Chemical, Ceramic and Pottery, etc.)—Board of Trustees, State College of Agriculture & Mechanical Arts, Athens, Ga., has work under way on addition including chemical, and ceramic and pottery laboratories and nitrition division. Donald McIver Construction Co., Candler Bldg., Atlanta, contractor.

Lead and Zinc Mill—Eagle-Picher Lead Co., Main and Commercial Sts., Cincinnati, O., awarded contract for construction of a 114 x 184 ft. lead and zinc concentration plant, including 68 x 68 x 71 ft., 1,200 ton and 50 x 112 x 26 ft. 5,000 ton capacity deep hoppers at Picher, Okla., to Tri-State Contractors, Inc., Tulsa.

Paper Plant—Cromwell Paper Co., 4801 South Whipple St., Chicago, Ill., awarded contract for a 1 story, 80 x 215 ft. addition to paper plant at 47th and Whipple Sts. to E. M. Sproule Construction Co., 2001 Pershing Road, Chicago. Estimated cost $50,000.

Paper Plant Addition—Owner, c/o Haenichen Engineering Co., 222 West Broadway, Paterson, N. J., Engrs., having preliminary plans prepared for a 2 story 90 x 200 ft. addition to paper plant at Slate Road and Delaware River. Estimated cost $40,000.

Paper Plant Addition — Paterson Parchment Paper Co., 35 8th St., Passaic, N. J., will soon award contract for construction of a 2 story, 90 x 200 ft. addition to parchment paper plant at Edgely, Pa. Estimated cost $80,000. Haenichen Engineering Co., Paterson, N. J., is architect and engineer.

Wax Paper Plant—Cleveland Wax Paper Co., 1311 Triskett Road, N. E., Cleveland, O., subsidiary of Detroit Wax Paper Co., Pleasant and New York Central R.R., Detroit, Mich., plans addition to plant at Cleveland. Estimated cost $40,000 including equipment.

Paper Mill — Thilmany Pulp & Paper Co., Kaukauna, Wis., awarded contract for a 1 story, 135 x 200 ft. paper mill to Permanent Construction Co., 735 North Water St., Milwaukee. Estimated cost $40,000.

Potash Mining Deposits—Texas Potash Co., Republic Bank Bldg., Dallas, Tex., receiving bids for sinking a 2,100 ft. shaft in connection with potash refining plant and mine unit in Ector and Midland Counties, Odessa. Estimated total cost $2,000,000.

Plaster Mill—Jumbo Plaster Mill Co., Siguard, Utah, receiving bids for structural steel for reconstruction of plaster mill destroyed by fire. Estimated total cost $250,000.

Pulp Products Plant—Berst-Foster-Dixfield Co., Grand Central Terminal, New York, N. Y., acquired former plant of Saranac Pulp & Paper Co., at Plattsburg, N. Y., and will adapt same for its use. Preliminary surveys being made for requirements used in manufacture of pulp products and wood novelties.

Rayon Plant Addition—Industrial Rayon Co., Hiram S. Rivitz, Pres., West 98th St., and Walford Ave., Cleveland, O., will soon award contract for a 1 story, 80 x 430 ft. addition to factory. Estimated cost $300,000. Christian, Schwarzenberg & Gaede Co., Union Bldg., Cleveland, are architects.

Refinery (Oil)—Anderson-Prichard Oil Corp., Oklahoma City, Okla., plans reconstruction of oil refinery destroyed by fire. Loss $80,000.

Refinery (Oil)—Burford Oil Co., Tulsa, Okla., plans extensions and improvements to oil refinery including equipment at Pecos, Tex. Estimated cost $100,000.

Refinery—Crude Oil Hydro Refining Corp., John C. Gray, Pres., 925 Main St., Bridgeport, Conn., leased a 25 acre site and will establish a plant for refining motor oil at Ledyard. Estimated cost to exceed $25,000. George Bilderbeck, 24 Ramsdell St., Groton, is engineer.

Refinery (Oil)—Joseph Elie, Ltd., 393 Hibernia Road, Montreal, Que., plans construction of oil refinery on Sherbrooke St. E. Estimated cost $1,000,000.

Soda Plant—Iowa Soda Products Co., c/o Harvey Pettigrew, V. Pres., Council Bluffs, Ia., plans construction of soda plant and furnishing and installing equipment including drying plants, grinders, filters, etc., at Rawlins, Wyo. Estimated cost $40,000.

Steel and Copper Mining Plants—United Soviet Socialist Russia, c/o Amtorg Trading Corp., 261 5th Ave., New York, N. Y., completed final plans for construction of a steel plant to include open hearth department, rolling mill, forge shop, press department, two heat-treating shops, tool and die department, laboratory, etc., at Kolpino, Leningrad Region. Approximately $75,000,000. Also plans copper mining and reducing plant, 400,000 tons annual capacity at Lake Balkash near Tashkent. Project includes roads, railroad construction, shops and other buildings. John K. Calder, Detroit, Mich., Engr. in charge. Work will be done by technical aid contracts.

Varnish Facotry—Payson Varnish Co., 141st St. and Southern Blvd., New York, N. Y., awarded contract for a 1 story, 49 x 95 ft. plant to James O'Toole, 2124 Newbold Ave., New York.

Vitrified Products Plant — American Vitrified Products Co., 15 Broad St., Akron, O., plans extensions and improvements to plant. Plans include kilns to be erected later in year, new loading dock, storage building, installation of a conveyor system together with improved pipe turners and revolving tables, automatic coal hoist, and electric drills for clay mines, etc., at Lisbon. Estimated cost $100,000.

INDUSTRIAL NOTES

ASSOCIATED ENGINEERS, 527 Fifth Ave., New York City, is the successor to F. J. Patchell & Co., under the active management of J. B. Spencer, Roy T. Wise and F. J. Patchell.

R. M. PALMER, consulting chemical engineer, has changed his address to 500 Fifth Ave., New York City.

PANGBORN CORP., Hagerstown, Md., has appointed W. O. Rosenberger as chief engineer.

INTERNATIONAL-STACEY CORP., Columbus, Ohio, has moved its offices at Fort Worth, Tex., to the Southland Life Insurance Co., Dallas, Tex.

FOOTE BROS. GEAR & MACHINE CO., Chicago, Ill., has appointed R. Wirth as Indianapolis representative with headquarters at 617 Merchants Bank Bldg.

ATLAS ELECTRIC DEVICES CO., Chicago, Ill., has appointed L. H. Bucher & Co., 274 Brannan St., San Francisco, as Pacific Coast representative.

BLAW-KNOX CO., Pittsburgh, Pa., and WESTERN PIPE & STEEL CO., San Francisco, Calif., have organized for the joint production and sale of the former's products on the Pacific Coast.

H. H. FISCHER & Co., consulting chemical engineers, at 24 Monroe Place, Brooklyn, N. Y., have become representatives of the Hermann Fischer Chemisch Technisches Bureau, Berlin.

BATTENFELD GREASE & OIL CORP., Kansas City, Mo., has merged with the Gibson-Homans Western Co.

BONNEY FORGE & TOOL WORKS has appointed G. Fred Sherman manager of sales at Allentown, Pa., and B. Bush in charge of sales in the East and H. S. Grimes in the Mid West.

SARCO CO., INC., New York City, has founded the Spirax Manufacturing Co., Ltd., in London.

NEILAN CO., LTD., and MASON REGULATOR Co. have established a joint office at 409 East Archer St., Tulsa, Okla., under Gordon Thomason.

CLARENCE T. HARRIS, consulting industrial chemist, has established a new office and laboratory at 174 Madison Ave., New York City.

COLD CARBONIC CORP., 11 West 42d St., New York City, has been organized as the exclusive distributor for solid carbon dioxide produced by the Pennsylvania Sugar Co., which is erecting at its plant in Philadelphia a 70-ton daily capacity solid carbon dioxide installation. Officers of the Cold Carbonic Corp., are J. B. Small, president; C. L. Jones, vice-president and treasurer; and Stewart Root, sales manager.